KURT SAXON'S THE WEAPONEER

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The Baltimore Steam Battery

Scientific American—May 25, 1861

See PMJB Vol. 1, page 64

The annexed engraving represents a perspective view, taken from a photograph, of the famous steam battery, about which so much has been said within a few weeks, as being in process of construction by the Messrs. Winans of Baltimore. From a letter by Mr. Thos. Winans, published in the Baltimore papers, it appears that the machine belongs to the city of Baltimore, and that the only ground for connecting the name of the Winanses with it is the fact that it was sent to their shop for repair. It was invented by Charles S. Dickinson, of Cleveland, Ohio, and patented August 9, 1859. Its capabilities and advantages are set forth in the following terms by the inventor:

"As a triumph of inventive genius, in the applications and practical demonstration of centrifugal force (that power which governs and controls the universe, and regulates and impels the motion of planetary bodies around the sun), this most efficient engine stands without a parallel, commanding wonder and admiration at the simplicity of its construction and the destructiveness of its effects, and is eventually destined to inaugurate a new era in the science of war.

Rendered ball proof, and protected by an iron cone, and mounted on a four-wheeled carriage, it can be readily moved from place to place, or kept on march with an army. It can be constructed to discharge missiles of any capacity from an ounce ball to a 25 pound shot, with a force and range equal to the most approved gunpowder projectiles, and can discharge from one hundred to five hundred balls per minute.

For city or harbor defense it would prove more efficient than the largest battery; for use on the battlefield, the musket caliber engine would mow down opposing troops as the scythe mows standing grain; and in sea fights, mounted on low-decke' steamers, it would be capable of sinking any ordinary vessels.

In addition to the advantages of power, continuous action and velocity of discharge, may be added economy in cost of construction, in space, in labor and transportation; all of which

Continued on Page 2

The Art of Weaponry

By Kurt Saxon

MEN have been fascinated by weapons since the first true men selected weapons worth keeping. Sub-men obviously hurled rocks and sticks at game, predators and other sub-men. But objects picked up and used once and then discarded are hardly weapons, except in a legal sense. The true weapon was an object worth keeping and carrying around.

Only when stones and clubs of the right shape and balance were appreciated and kept, could the art of weaponry advance. Only then did man rise above the animals and dominate the earth.

So the appreciation of weapons is an almost instinctive preoccupation of the most practical of our species. Moreover, danger to the system inspires farsighted men to arm themselves and their fellows.

The student of weaponry, as well as the professional weaponeer, is an asset to his culture. The more he knows, the more territory he can defend, either as an individual or by supplying less well-armed friends and neighbors. There is also a strong profit motive in making weapons to sell.

THE WEAPONEER details weapons of all kinds and all eras and explains how they work.

The 1883 gunsmithing course will be of practical interest to modern gunsmiths, gun collectors and those who would like to reproduce or repair the old models. It also shows how the Afghans and Pakistanis make their guns as there is a lot of hand work described. (Now in BLACK POWDER GUNSMITH)

The other 19th Century reprints of weapons developed before and during the American Civil War illustrates the intellectual interest in weaponry by our most respected ancestors.

For those who like medieval weaponry, to reproduce as working models, or as attractive wall hangings to sell, the Popular Mechanics series will be appreciated.

THE WEAPONEEER also details improvised weaponry in the finest tradition of THE POOR MAN'S JAMES BOND. Regardless of the availability of conventional weaponry you can feel secure.

You will be able to defend your home and loved ones with the most outrageous infernal gagetry imaginable. Your territory will be a nightmare of boobytraps, mines and alarm devices.

Suffice it to say that, although the knowledge in THE WEAPONEER is legal, its *application* may be a felony, but that's your lookout.

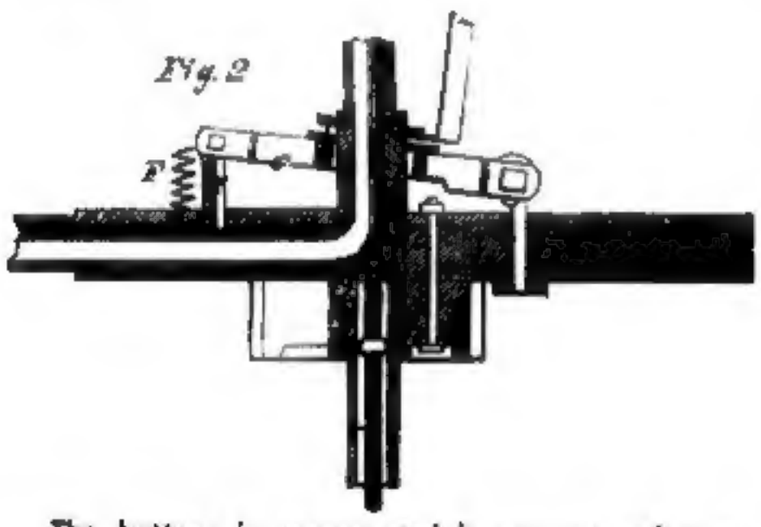
I take no moral stance. I will leave moral considerations up to the individual. Knowledge must be available to anyone who wants it for whatever purpose, whether practical or whimsical. Individuals who cannot be trusted with lethal

would be small in comparison to the cost and working of batteries of cannon, and the equipment and management of a proportionate force of infantry. The possession of this engine—ball proof and cased in iron—will give the powers using it such decided advantages as will strike terror to the hearts of opposing forces, and render its possessors impregnable to armies provided with ordinary offensive weapons.

Its efficiency will soon be practically demonstrated, and the day is not far distant when, through its instrumentality, the new era in the science of war being inaugurated, it will be generally adopted by the Powers of the Old and New Worlds, and, from its very destructiveness, will prove the means and medium of peace."

The construction of the gun is represented in Fig. 2. A steel gun barrell, bent at an elbow as shown, is caused to revolve by steam power with great velocity; when the balls, being fed into the perpendicular portion, which is at the center of revolution, are thrown out of the horizontal arm by centrifugal force. A gate, J, keeps the balls from flying out until the barrel is in the desired position, when this gate is opened by the action of the lever, C, and the balls permitted to escape.

To make sure against accident from the chance issuing of balls when the barrel is not in the proper position, a strong wrought iron casing surrounds the gun, with a slit in one side through which the balls may pass, as shown in Fig. 1. Our cut represents the balls as being fed in singly by hand, but in action it is proposed to feed them in with a shovel. Mr. Winans says that the shot from this gun will cut off a nine inch scantling at the distance of half a mile.



The battery is represented in our engraving as standing in front of messrs. Winans' extensive works in Baltimore, a part of the buildings being represented.

In 1837, Benjamin Reynolds, of Kinderhook, N.Y., constructed a centrifugal war engine for discharging bullets in a stream from a tube. It was operated by two men, one standing at each side working a crank, and turning it in the same manner as two men operate a windlass. The bullets, we understand, were taken from a hopper at the center of a revolving drum and thrown out at the circumference, the action being similar to that of a rotary pump. A small war engine of Mr. Reynolds' was tried at West Point, in 1837, before General Worth and several other officers of the United States Army, and it is stated that, at 110 yards distance from the target, it sent 1,000 2-ounce balls in a minute, through 3¼ inches of hard pine plank.

knowledge should be put away. Responsible citizens must be free to do as they please and not be bound by restrictions normally placed on an irresponsible minority.

I will not play the role of public guardian. I will not hold back information from decent people because a few morons and psychotics might buy the book.

As world civilization crumbles, the Liberal hearts go out to the degenerates causing its fall. The decent citizen is ignored and increasingly disarmed. The predator is favored over his victim.

With THE WEAPONEER, I hope to turn the tide. Let the authorities remove the cancer from our societies, rather than enslaving us on their behalf. If their rights are to be considered above ours, we have no recourse but to go for overkill.

If dangerous parasites are to be favored over good citizens, then good citizens must become even more dangerous. This won't save our system. It's too late. But we will thereby defeat them and thus survive.

ATLAN will proceed to publish material which will enable anyone, regardless of his situation, to defeat any antagonist. I provide knowledge of the weapons needed for any contingency.

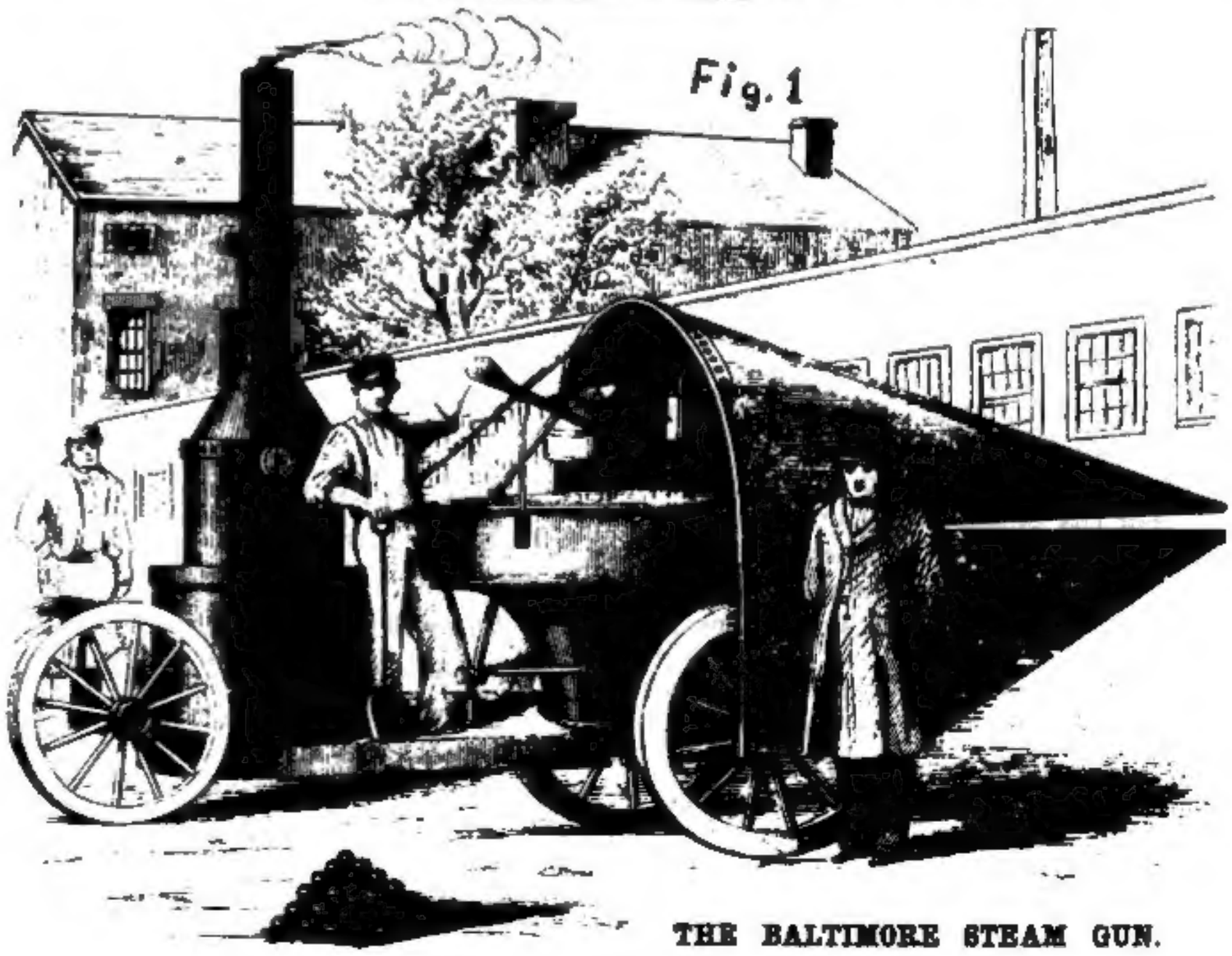
My definition of a weapon is any method of overcoming an enemy. It may involve simply outthinking him with a good mind, harrassing him with dirty tricks, thwarting him with legal machinations or eliminating him with deadly force.

Even so, this knowledge is not simply being thrown to the winds. There has at least been an attempt at selection. ATLAN'S goal in THE WEAPONEER is to arm the best in our society against the worst. We will advertise only in adult magazines geared to the thinking of our kind of people.

If you were sent a copy of THE WEAPONEER, it is because you are probably alert to the decline of our system. This alone makes you one of the elite, worthy of being so armed. You either have something of value to offer the next generation or can help destroy those who would be a threat to the next generation.

You may neither have the moxie nor the background to master all the skills in the first twelve issues. But as the course unfolds, you'll so far outstrip your foes that they'll be putty in your hands, if you let them live at all.

If the subject matter seems harsh, you must realize you're living in a harsh world. Moreover, things will get worse before we can make them better. If you are what you hope you are; if you can be what you may have to be to continue, you'll drop your illusions fast. Only realists will be a functional part of the future.



THE BALTIMORE STEAM GUN.

After this it was taken to Washington, and experiments made with it before a committee of Congress and several military officers, with results similar to those obtained at West Point. At this trial the committee exercised great perseverance; first, in regard to its power and range, and, second, in regard to the number of shots projected in a given time.

On this occasion the power applied was as before, one man at each of the two cranks. The target, three thicknesses of one inch pine planks, at the distance of 150 yards. Each ball was projected through the target, falling from three to four hundred yards beyond it into the Potomac River. They were not so successful, however, in determining the number of shots thrown in a given time. In this test sixty balls of 2 oz. were placed in a tin tube of sufficient size and length to contain them. One end of the tube was then placed at the admitting orifice of the battery, into which they were carried by the action of gravity and the exhausting disposition of the machine. The space of time taken for the projection of sixty shots was so small a portion of a second that the committee could not report any specific space of time at all.

The Scientific American — June 1861

ABSURDITY OF STEAM AND CENTRIFUGAL GUNS.

The public mind has been somewhat exercised respecting the steam gun which was captured on its trip from Baltimore to Harper's Ferry, but nothing can be more absurd than the attempts which have been made to apply steam directly and indirectly in projecting bullets—large and small—for purposes of warfare. To project 32-pound balls by centrifugal mechanism, a steam engine of no less than 60-horse power is necessary. With a cannon, we can obtain the same result with eight pounds of gunpowder for every shot. For discharging bullets by steam power, a furnace, a boiler, steam engine and centrifugal machine are required; with gunpowder, the cannon answers for furnace, boiler, engine and projecting machine. How complicated the mechanism by the former method—how simple the latter.

The principles of science lead us to pronounce emphatically against steam when compared with gunpowder, as an expansive agent for projecting shot. The ignition and expansion of gunpowder is almost instantaneous, and it is applied directly to project the missile. The heat of burning fuel used in generating steam is really the primary force in the boiler, just as the heat of the ignited gunpowder is in the cannon. The difference between the instantaneous combustion of the powder and the slow combustion of the coal will convince any person how superior the former is to the latter as a force for projecting missiles of war. The powder is more expensive than coal, but it is no more expensive than it is superlatively effective.

Jacob Perkins(our countryman,residing in London), obtained a patent May 15, 1824. The shell was filled partially with water, and was closed at the rear end with a fusible metal plug. It was placed in a highly heated furnace, and so arranged in connection with a discharging tube that, when it attained to a very high temperature, the plug melted, the steam then flashed out, and, by its reaction, threw the shell out of the tube. It was an attempt to use steam as a substitute for gunpowder in shells, and was a failure. The centrifugal gun of Robert McCarty, of this city, which has been tried two or three times recently at the foot of Thirty-third street, North river, was patented as far back as December 31, 1838. It is essentially composed of a hollow revolving wheel, which discharges its balls through a tube at the periphery by centrifugal action. By applying a steam engine to drive the wheel of this gun, instead of two men working cranks, we really have the Baltimore gun in its most essential features.

On the 21st of December, 1854, A. Smith, D. McKenzie and James Thompson, of England, took out a patent for discharging bullets from a gun by using very high pressure steam as a substitute for powder. The steam was contained in a very strong, small boiler, and was admitted and cut off by a valve to discharge the shot in the same manner that steam is admitted behind a piston in an engine. The boiler was surrounded by a bath of molten metal heated to 1,100° Fah. This was a true, but a very foolish steam gun.

An anecdote is told of the Duke of Wellington to the effect that, after having examined Perkins' steam gun with great attention, and having asked a number of pertinent questions relating to its weight, the means of moving it, getting up steam, &c., he dryly observed, "Well, if steam guns had been invented first what a capital improvement gunpowder would have been." We do not consider that the Duke of Wellington's opinions were infallible respecting inventions, or that he was a man of what may be called "brilliant intellect," but he had a vast fund of plain common sense, and the multitudinous appendages of the steam gun convinced him that it was unfit for the purposes of war. A steam gun could throw a stream of bullets upon the advancing head of a storming column, but with four guns in battery a perfect stream of canister may also be thrown upon an attacking party and produce more destructive results.

REBUTTAL TO "ABSURDITY"

By Kurt Saxon

The principal of hurling missiles by centrifugal force by steam or gas engine is sound. The objection that eight pounds of gunpowder is cheaper than maintaining a 60 horsepower engine is absurd. The average small car of today gives up to 100 horsepower and a large pickup will get up to 400. I suppose a tank would get a couple of thousand horsepower.

So, for today's machinery the centrifugal cannon or machinegun would be very economical, compact and mobile. I don't know why the concept was abandoned, except maybe for the design of the vehicle as shown on page one. Now, anyone could adapt the principal, turning his runabout into a battle wagon of ferocious power.

Survival Shooting

By Ralph Abbott

I am speaking to those of you who are proficient with firearms who would like to learn point shooting.

Point shooting is a method of shooting without the use of sights and is valuable in low light conditions and when you need to get off a shot faster than you can acquire a sight picture, sometimes it is called snap shooting.

Point shooting is as instinctive as pointing your finger but polishing it to precision takes many hours of practice with expensive ammo. Until now.

I have developed a method of teaching point shooting in a very short time without the use of ammunition that you can learn in your living room.

Point shooting is most often used with a pistol but is very effective with a rifle also.

Here is my method:

First of all unload your weapon. Next select a target such as a calendar or picture, stand across the room facing the target in a normal stance, weapon in hand.

Stare at the target long enough to fix the location in your mind, close your eyes, and point the weapon at the target, quickly open your eyes and check the sight allignment.

Off a little? Try again correcting the sight picture each time until y ou can point at a large target every time with your eyes closed.

When you have progressed this far, change to a smaller target. By progressing to smaller targets, you should be able to point to a target the size of a dime in about 3 or 4 weeks of practice.

It is important to practice no more than 10 minutes at a time in order not to become tired, which will throw off your co-ordination. You may practice 2 or 3 times a day but for ten minutes each session.

Do not fire live ammunition until you have practiced long enough to point at the smallest target that your co-ordination will allow. This forces you to use your instinctive abilities and you will be surprised at the results when you do go to a target range or your favorite plinking grounds.

I do not pretend to be a technical expert on firearms or shooting. Paper targets leave me with a case of the blahs and silouette shooting is not my bag. I leave the chickens cackeling and the rams baaing.

What I am is a survival shooter. This means putting meat on the table in every situation which it is possible to encounter with the least waste of either meat or ammunition.

Ralph Abbott
"Country Cousin"

The Nasal Sprayer As a Weapon

Plus: The most effective loads

By Kurt Saxon

For a concealable weapon, as deadly as you want to make it, you can't beat the nasal spray (not mist). Sprays holding antihistamines can be found in any grocery or drug store for about $1.39 or less. Vicks, Dristan and several other brands will give you all you need to fight off or kill any attacker.

They are easily emptied of their legitimate contents and refilled with whatever liquid substance you choose. Simply tilt the spray toward the sink and squeeze repeatedly until empty.

Since the contents are non-toxic you might use the original medicine to practice on a target across the room.

To refill, just put the poison you like best in a bowl, squeeze the emptied sprayer and stick it's nozzle under the liquid. Release the pressure and a lot of liquid will be sucked up.

If it doesn't seem to want to suck in, just hold it by it's sides and squeeze and that will force the flat front and back to draw up the liquid. It might take a few squeezings to get it completely filled. When nearly full, hold it up to a light and squeeze until a drop appears to be coming out of it's nozzle. Then poke it down into the liquid and release the pressure and it will be completely full.

Most nasal sprays have screw caps which take about two full turns to remove. If you have time, this is fine. But if you are stopped by a mugger he might not give you time to unscrew the thing.

So if you are in a really unsafe area, carry it uncapped in your hand. You might also carry it uncapped in your shirt pocket. But be careful to have something else in your pocket to prevent it from tipping over.

The beauty of such a weapon is that it will pass a search unless the searcher suspects it, but only if the searcher believes you to be more clever than you are, which is unlikely. No one is going to suspect a common nasal inhaler in your pocket.

You can even take the deadliest load on a commercial airliner without being detected. However, when going up in a small plane, make sure the inhaler is completely full. If it is only partly full, the air inside will expand and cause it to leak. So watch that!

The best all purpose load is Formaldehyde. It is highly volatile and penetrating. When sprayed into an attacker's face it causes terrible pain in the eyes, nose and mouth. The victim is totally out of action for about thirty minutes. It will stop the strongest man. Unless he has a gun pointed directly at you and pulls the trigger by reflex, one shot in the face with Formaldehyde will allow you to disarm him or walk away without any danger to yourself.

I recently ordered a gallon of Formaldehyde from my drug store and got it, no questions asked, for $7.50. Most pharmacists will order various chemicals for you if they know you and know you will be around to collect it.

If they ask what you want a chemical for, it is usually just out of idle curiosity. Or possibly it is to establish the fact that you have a practical use for it and aren't ordering something you don't understand. Otherwise, the guy wants to make a sale and unless you look wierd, he doesn't care.

So when ordering a chemical not usually stocked on the druggist's shelves, make up a simple cover story. Look the chemical up in a chemistry book or encyclopedia and find it's uses. Choose a common use and tell your druggist that is what you want it for. For instance, you might tell him you want Formaldehyde to preserve lab specimens. This is com-

Imitation Arms and Armor

Popular Mechanics—1913

PART 1

Genuine antique swords and armor, as used by the knights and soldiers in the days of old, are very expensive and at the present time practically impossible to obtain. The accompanying illustration shows four designs of swords that anyone can make, and if carefully made, they will look very much like the genuine article.

The drawings are so plain that the amateur armorer should have very little difficulty, if any, in building up his work from the illustrations, whether he requires a single sword only, or a complete suit of armor, full size.

Fig. 1

Fig. 2

Fig. 3

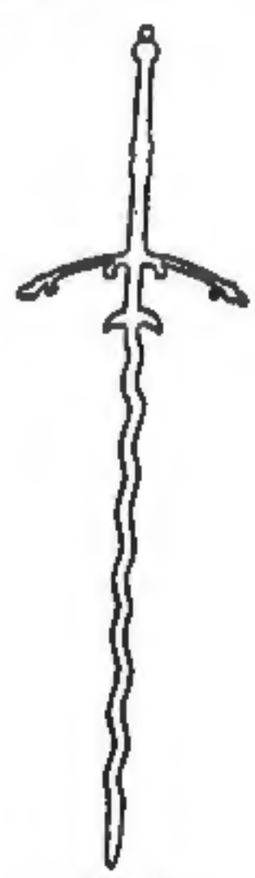


Fig. 4

The pieces or designs in this article are from authentic sources, says the English Mechanic, so that where names are given the amateur can so label them, and will thereby greatly add to their interest and value.

An executioners' sword of the fifteenth century is shown in Fig. 1. The blade should be about 27 in. long with a handle of sufficient length to be grasped by both hands. The width of the blade near the handle is about 2½ in., tapering down to 1½ in. near the point end. Several ridges are cut around the handle to permit a firm grip. The cross guard is flat and about 1 in. in width.

Mark out the shape and size of the blade on a piece of wood ⅛ in. thick, using a straightedge and a pencil, and allowing a few inches more in length on which to fasten the handle. Cut out the wood with a scroll saw or a keyhole saw, trim the edges down thin and smooth both surfaces with fine sandpaper. The end for the handle is cut about 1 in. wide and 2 in. long. The cross guard is cut out and a hole made in the center through which to pass the handle end of the blade. The handle is next made, and if the amateur does not possess a lathe on which to turn the shape of the handle, the ridges around the wood may be imitated by gluing and tacking on pieces of small rope. The handle is then mortised to receive the 1 by 2-in. end of the blade. The cross guard is now glued and placed on the blade, then the hole in the handle is well glued with glue that is not too thick and quite hot. The blade with the cross guard is inserted in the handle and allowed to set. When the glue is thoroughly dry, remove the surplus with a sharp knife and paint the handle with brown, dark red, or green oil paint. The blade is covered with tinfoil to give it the appearance of steel. Secure some pieces of tinfoil and cut one strip ½ in. wider than the blade and the other ¼ in. narrower. Quickly paint the blade well with thin glue on one side, then lay evenly and press on the narrow strip of tinfoil. Glue the other side of the blade, put on the wider strip of tinfoil and glue the

mon and so should arouse no suspicion.

If your druggist does not care to put in special orders and you have no other source for Formaldehyde, you can make up some acrolein or capsicum from easily gotten materials. PMJB 1 PAGE 18.

It may be that you admired Charles Bronson in "Death Wish", wherein our hero actually killed all the muggers he could. After all, why simply incapacitate a brute only to have him lay for you at a later time?

The best instant killer is Prussic Acid. You can make it easily by following the directions on page 50 of The Poor Man's James Bond, Vol. 1.

Although anyone with easily obtained lab gear can make Prussic Acid, you may want a simpler poison. One such as Black Leaf 40 which is Nicotine Sulphate, bought at your local garden store. To use this properly, you need DMSO (Dimethyl Sulfoxide). DMSO is a chemical claimed to be of use in relieving the pain of arthritis. It penetrates the skin and takes any water soluable chemical into the blood stream in seconds.

If a garden herbicide or insecticide has a warning not to be left on the skin, you can be sure DMSO will take it into the blood stream twice as fast as it would orindarily go, fatally.

A diabolical use for DMSO and the poison of your choice is to spread it on your opponent's steering wheel. It dries in about 30 minutes and is not noticeable.

After driving a while, he would apparently have a stroke or heart attack. There is little likelihood that there would be an autopsy, especially if he wrecked the car. Even so, who could prove anything?

DMSO is illegal in most states because of the FDA's doubts of it's safety. Even so, it is advertised for over $20.00 a pint in various periodicals such as THE SPOTLIGHT. You can get it from any veterinarian for about $10.00 a pint. Just tell the vet you have an old dog or horse who has arthritis. That is what the vets use and sell it for. It is sold at the Harrison Health Food Store. Try yours.

To make your lethal load of Black Leaf 40-DMSO, just pour out a 2 ounce bottle of Black Leaf 40 into a saucer and let it evaporate to half it's volume or one ounce. Then mix it with an equal amount of DMSO. You now have two ounces of liquid, a good squirt of which is guaranteed to kill in three minutes.

But maybe you are in a hurry. Try Potassium Cyanide in saturation. That is when you put so much Cyanide in a stoppered test tube with water and after shaking vigorously (the test tube) there is still some cyanide left at the bottom. This means the water cannot hold any more in solution.

In case you can't get Cyanide, you can make all you want from the recipe on page 82 of PMJB Vol. 1.

Mix the Cyanide solution with an equal volume of DMSO. A hefty squirt of this is guaranteed to kill in two minutes.

Okay, so you squirt an opponent with one of the above and he kicks you to death before he dies. Don't worry; I'm ahead of you.

What you do is mix one-third poison, one-third DMSO, and one-third Formaldehyde. The one-third Formaldehyde will put an attacker out of action as surely as if you had dunked his head in a bucket of it. His pain will soon be over.

If you think the one-third poison isn't enough, you now have time to empty the inhaler on him. But all kidding aside, one or two good squirts in the face will do the job.

So now you have the ultimate weapon for defense against an attacker. But maybe you want to put someone away without your victim or anyone else knowing. Do you remember that Belgian who got stabbed in the flank by a Russian agent with a sharp umbrella? A tiny metal pellet left in his body did him in. Three days later he developed what was believed to be pneumonia and died.

A couple of little-bitty holes were drilled in the little metal ball and filled with ricin. Enough ricin to cover the head of a straight pin is fatal in three days.

You don't need the sharp umbrella or even the little metal ball. All you need is the ricin and I'll show you how to make it on page 23.

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from page 4

overlapping edge and press it around and on the surface of the narrow strip. The cross guard must be covered with tinfoil in the same manner as the blade. When the whole is quite dry, wipe the blade with light strokes up and down several times, using a soft and dry piece of cloth. The sword is then ready to hang in its chosen place as a decoration, not for use only in cases of tableaux, for which this article will be especially useful to those who are arranging living pictures wherein swords and armor are part of the paraphernalia.

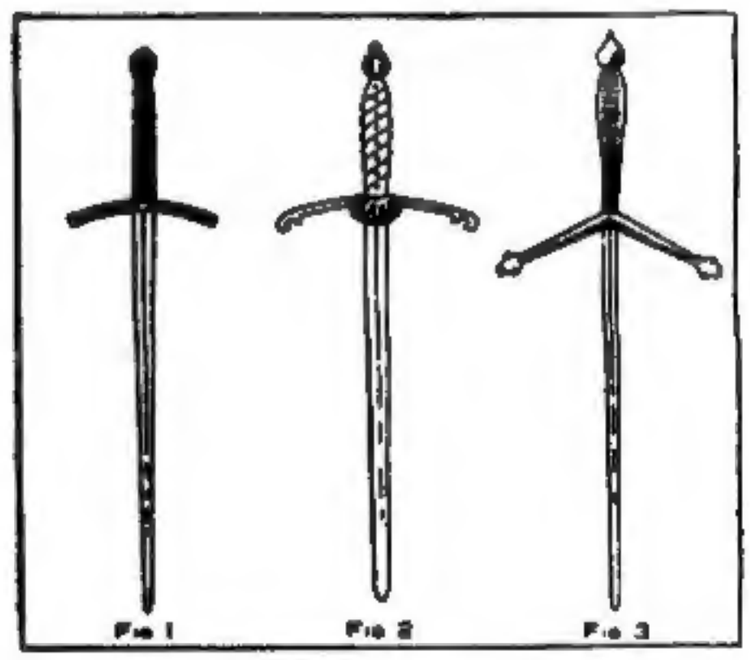
A Chinese scimitar is shown in Fig. 2. The handle of this sword is oval and covered with plaited cord. In making this scimitar, follow the directions as for Fig. 1, except that the handle has to be covered with a round black cord. If it is found difficult to plait the cord on the handle as in the illustration, wind it around in a continuous line closely together, and finish by fastening with a little glue and a small tack driven through the cord into the handle. The pommel is a circular piece of wood, ⅛ in. thick and 5 in. in diameter. The length of the handle, allowing for a good hold with both hands, should be about 9 in., the length of the blade 28 in., the width near the pommel 1½ in. and 3 in. in the widest part at the lower end. The sharp or cutting edge is only on the short side, the other is flat or half-round.

A Turkish sabre of ancient manufacture from Constantinople is shown in Fig. 3. The handle is painted a dull creamy white in imitation of ivory. The enamel paint sold in small tins will answer well for this purpose. The cross guard and blade are covered as described in Fig. 1. The sharp edge is on the longer curved side, the other is flat or half-round.

A two-handed sword used in the 14th and 15th centuries is shown in Fig. 4. This sword is about 68 in. long, has a cross guard and blade of steel with a round wood handle painted black. The ball or pommel on top of the handle is steel. Both edges of the blade are sharp. This sword is made in wood the same as described for Fig. 1.

PART II

Imitation swords, stilettos and battle-axes, put up as ornaments, will look well if they are arranged on a shield which is hung high up on a wall of a room or hall, says the English Mechanic, London. The following described arms are authentic designs of the original articles. A German sword of the fifteenth century is shown in Fig. 1. This sword is 4 ft. long with the crossguard and blade of steel. The imitation sword is made of wood and covered with tinfoil to produce the steel



Three Fifteenth Century Swords

color. The shape of the sword is marked out on a piece of wood that is about ⅛ in. thick with the aid of a straightedge and pencil, allowing a little extra length on which to fasten the handle. Cut the sword out with a saw and make both edges thin like a knife blade and smooth up with sandpaper. The extra length for the handle is cut about 1 in. in width and 9 in. long. The handle is next carved and a mortise cut in one end to receive the handle end of the blade. As the handle is to represent copper, the ornamentations can be built up of wire, string, small rope and round-headed nails, the

whole finally having a thin coat of glue worked over it with a stiff bristle brush and finished with bronze paint.

The crossbar is flat and about 1 in. in width. Cut this out of a piece of wood and make a center hole to fit over the extra length on the blade, glue and put it in place. Fill the hole in the handle with glue and put it on the blade. When the glue is thoroughly dry, remove all the surplus with a sharp knife. Sheets of tinfoil are secured for covering the blade. Cut two strips of tinfoil, one about ½ in. wider than the blade and the other ¼ in. narrower. Quickly cover one side of the blade with a thin coat of glue and evenly lay on and press down the narrow strip of tinfoil. Stick the wider strip on the other side in the same way, allowing equal margin of tinfoil to overlap the edges of the blade. Glue the overlapping edges and press them around on the surface of the narrow strip. The crossguard must be covered in the same manner as the blade. When the whole is quite dry, wipe the blade up and down several times with light strokes using a soft rag.

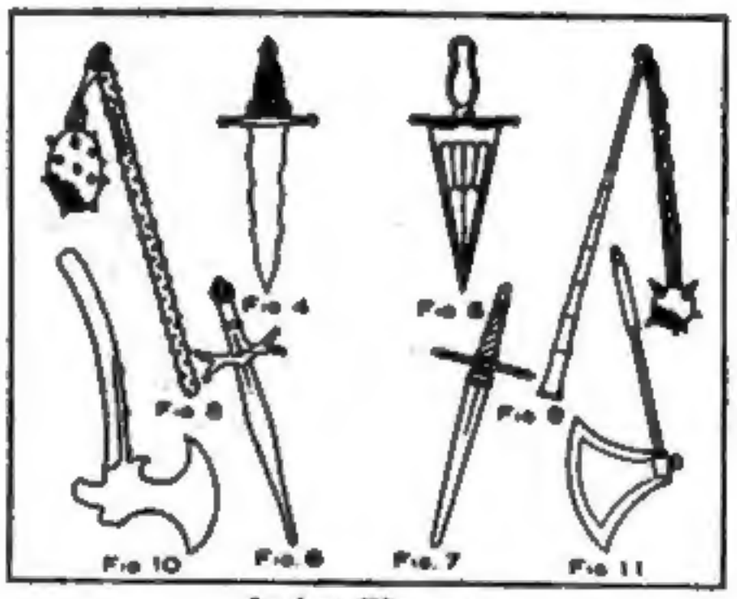
The sword shown in Fig. 2 is a two-handed Swiss sword about 4 ft. in length, sharp on both edges with a handle of dark wood around which is wound spirally a heavy piece of brass or copper wire and held in place with round-headed brass nails. The blade and crossbar are in imitation steel. The projecting ornament in the center of the crossguard may be cut from heavy pasteboard and bent into shape, then glued on the blade as shown.

In Fig. 3 is shown a claymore, or Scottish sword of the fifteenth century. This sword is about 4 ft. long and has a wood handle bound closely around with heavy cord. The crossbar and blade are steel, with both edges sharp. A German poniard is shown in Fig. 4. This weapon is about 1 ft. long, very broad, with wire or string bound handle, sharp edges on both sides. Another poniard of the fourteenth century is shown in Fig. 5. This weapon is also about 1 ft. long with wood handle and steel embossed blade. A sixteenth century German poniard is shown in Fig. 6. The blade and ornamental crossbar is of steel, with both edges of the blade sharp. The handle is of wood. A German stiletto, sometimes called cuirass breakers, is shown in Fig. 7. This stiletto has a wood handle, steel crossbar and blade of steel with both edges sharp.

In Fig. 8 is shown a short-handled flail, which is about 2½ ft. long with a dark handle of wood, studded with brass or steel nails. A steel band is placed around the handle near the top. The imitation of the steel band is made by gluing a piece of tinfoil on a strip of cardboard and tacking it to the handle. A large screweye is screwed into the top of the handle. The spiked ball may be made of wood or clay. Cover the ball with some pieces of linen, firmly glued on. When dry, paint it a dark brown or black. A large screweye must be inserted in this ball, the same as used on the end of the handle, and both eyes connected with a small piece of rope twisted into shape. The rope is finished by covering with tinfoil. Some short and heavy spike-headed nails are driven into the ball to give it the appearance shown in the illustration.

A Russian knout is shown in Fig. 9. The lower half of the handle is of wood, the upper part iron or steel, which can be imitated by covering a piece of wood that is properly shaped with tinfoil. The whole handle can be made of wood in one piece, the lower part painted black and the upper part covered with tinfoil. A screweye is screwed into the upper end. A length of real iron or steel chain is used to connect the handle with the ball. The ball is made as described in Fig. 8. The spikes in the ball are about 1 in. in length. These must be cut from pieces of wood, leaving a small peg at the end and in the center about the size of a No. 20 spike. The pegs are glued and inserted into holes drilled into the ball.

In Fig. 10 is shown a Sclavonic horseman's battle-axe which has a handle of wood painted dark gray or light brown; the axe is of steel. The blade is cut from a piece of ¼-in. wood with a keyhole saw. The round part is made thin and sharp on the edge. The thick hammer side of the axe is built up to the necessary thickness to cover



Ancient Weapons

the handle by gluing on pieces of wood the same thickness as used for the blade, and gradually shaping off to the middle of the axe by the use of a chisel, finishing with sandpaper and covering with tinfoil. Three large, round-headed brass or iron nails fixed into the front side of the handle will complete the axe.

At the beginning of the sixteenth century horseman's battle-axes shaped as shown in Fig. 11 were used. Both handle and axe are of steel. This axe is made similar to the one described in Fig. 10. When the woodwork is finished the handle and axe are covered with tinfoil.

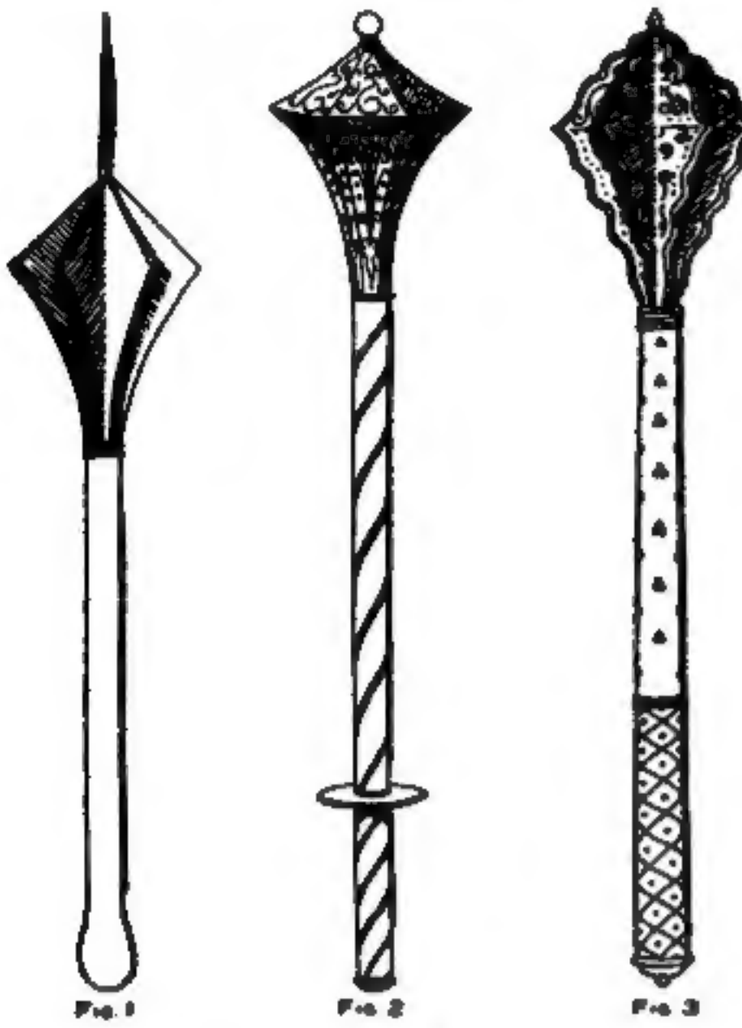
PART III

Maces and battle-axes patterned after and made in imitation of the ancient weapons which were used from the fourteenth to the sixteenth century produce fine ornaments for the hall or den, says the English Mechanic. The imitation articles are made of wood, the steel parts represented by tinfoil stuck on with glue and the ornaments carved out with a carving tool.

An English mace used about the middle of the fifteenth century is shown in Fig. 1. The entire length of this weapon is about 24 in.; the handle is round with a four-sided sharp spike extending out from the points of six triangular shaped wings. Cut the handle and spike from one piece of wood and glue the wings on at equal distances apart around the base of the spike. The two bands or wings can be made by gluing two pieces of rope around the handle and fastening it with tacks. These rings can be carved out, but they are somewhat difficult to make. After the glue is dry, remove all the surplus that has been pressed out from the joints with the point of a sharp knife blade and then sandpaper the surface of the wood to make it smooth. Secure some tinfoil to cover the parts in imitation of steel. A thin coat of glue is quickly applied to the surface of the wood and the tinfoil laid on evenly so there will be no wrinkles and without making any more seams than is necessary. The entire weapon, handle and all, is to appear as steel.

An engraved iron mace of the fifteenth century is shown in Fig. 2. This weapon is about 22 in. long, mounted with an eight-sided or octagonal head. It will be easier to make this mace in three pieces, the octagonal head in one piece and the handle in two parts, so that the circular shield shown at the lower end of the handle can be easily placed between the parts. The circular piece or shield can be cut from a piece of wood about ¼ in. thick. The circle is marked out with a compass. A hole is made through the center for the dowel of the two handle parts when they are put together. A wood peg about 2 in. long serves as the dowel. A hole is bored in the end of both handle pieces and these holes well coated with glue, the wood peg inserted in one of them, the shield put on in place and handle parts put together and left for the glue to set. The head is fastened on the end of the handle with a dowel in the same manner as putting the handle parts together.

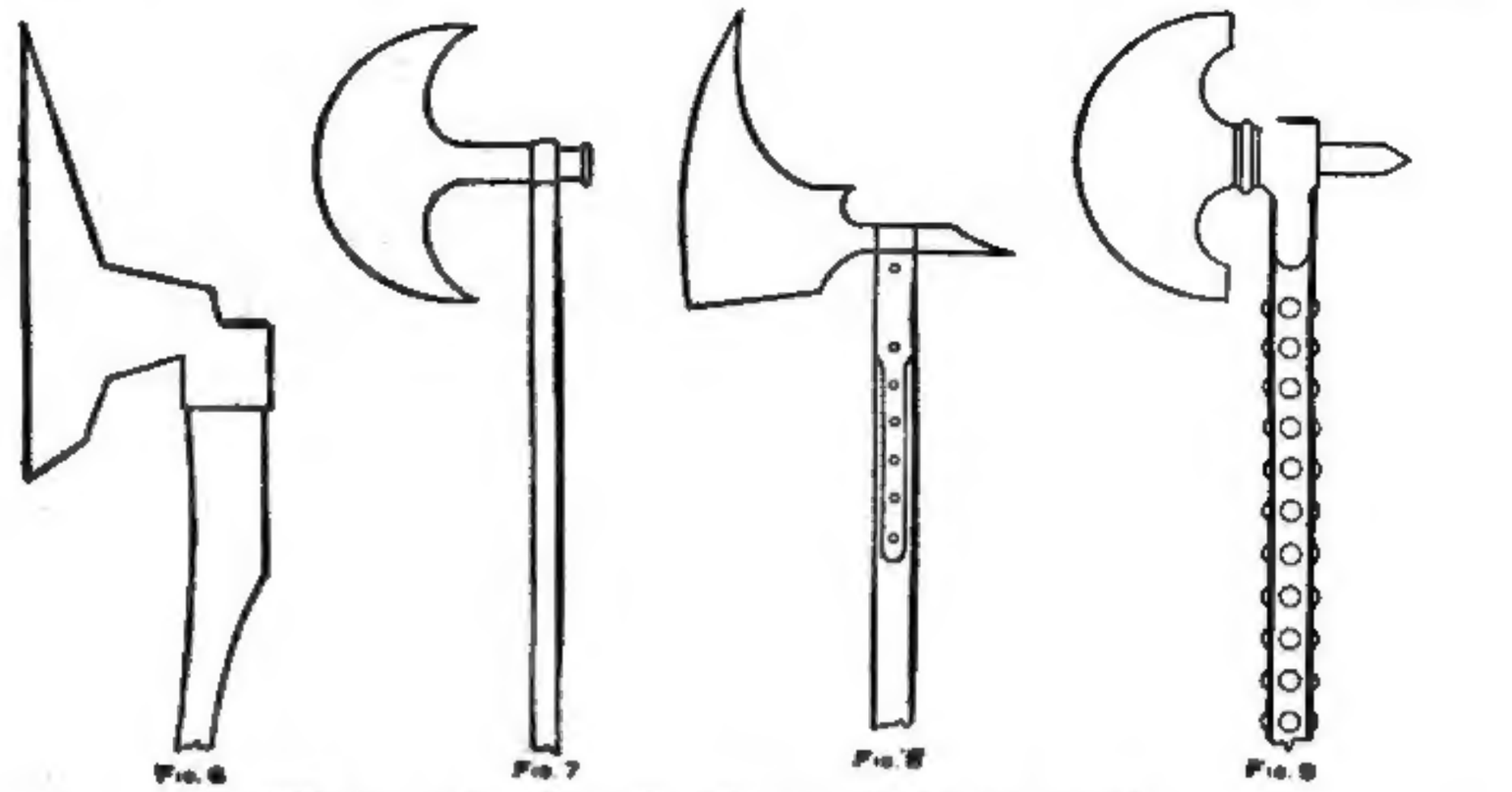
The head must have a pattern sketched upon each side in pencil marks, such as ornamental scrolls, leaves, flowers, etc. These ornaments must be carved out to a depth of about



Ancient Weapons

¼ in. with a sharp carving tool. If such a tool is not at hand, or the amateur cannot use it well, an excellent substitute will be found in using a sharp-pointed and red-hot poker, or pieces of heavy wire heated to burn out the pattern to the desired depth. The handle also has a scroll to be engraved. When the whole is finished and cleaned up, it is covered with tinfoil in imitation of steel. The tinfoil should be applied carefully, as before mentioned, and firmly pressed into the engraved parts with the finger tips or thumb.

A French mace used in the sixteenth century is shown in Fig. 3. This weapon is about 22 in. long and has a wood handle covered with dark red cloth or velvet, the lower part to have a gold or red silk cord wound around it, as shown, the whole handle finished



Battle Axes of the Fourteenth, Fifteenth and Sixteenth Centuries

off with small brass-headed nails. The top has six ornamental carved wings which are cut out, fastened on the handle and covered with tinfoil, as described in Fig. 2.

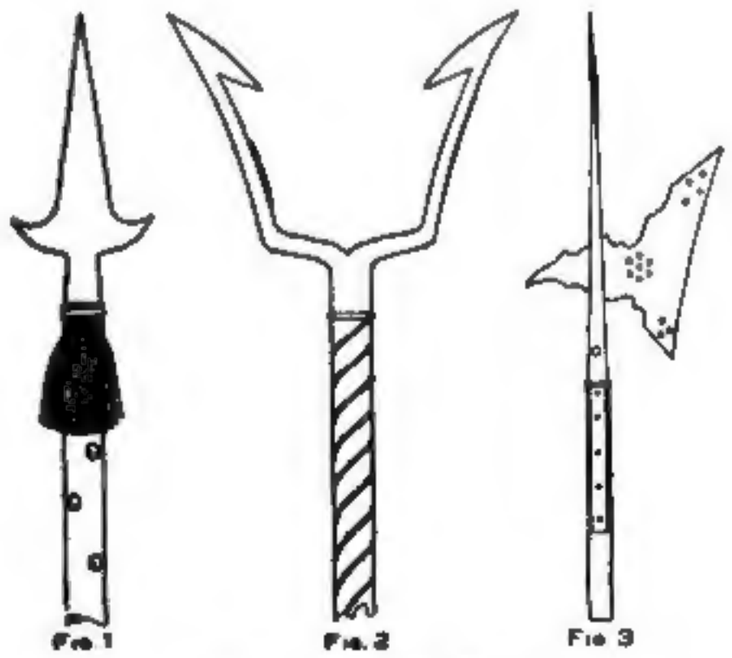
Figure 4 shows a Morning Star which is about 26 in. long. The spiked ball and the four-sided and sharp-pointed spike are of steel. The ball may be made of clay or wood and covered with tinfoil. The spikes are cut out of wood, sharp-pointed and cone-shaped, the base having a brad to stick into the ball. The wood spikes are also covered with tinfoil. The handle is of steel imitation, covered in the middle with red cloth or velvet and studded with large-headed steel nails.

A war hammer of the fifteenth century is shown in Fig. 5. Its length is about 3 ft. The lower half of the handle is wood, covered with red velvet, with a golden or yellow cord wound spirally over the cloth. The upper half of the handle is steel, also, the hammer and spike. The entire handle should be made of one piece, then the hammer put on the base of the spike. The spike made with a peg in its lower end and well glued, can be firmly placed in position by the peg fitting in a hole made for its reception in the top of the handle. Finish up the steel parts with tinfoil.

The following described weapons can be constructed of the same materials and built up in the same way as described in the foregoing articles: A horseman's short-handled battle-axe, used at the end of the fifteenth century, is shown in Fig. 6. The handle is of wood and the axe in imitation steel. Figure 7 shows an English horseman's battle-axe used at the beginning of the reign of Queen Elizabeth. The handle and axe both are to be shown in steel. A German foot soldier's poleaxe used at the end of the fourteenth century is shown in Fig. 8. The handle is made of dark wood and the axe covered with tinfoil. Figure 9 shows an English foot soldier's jedburgh axe of the sixteenth century. The handle is of wood, studded with large brass or steel nails. The axe is shown in steel. All of these axes are about the same length.

The ancient arms of defense as shown in the accompanying illustrations make good ornaments for the den if they are cut from wood and finished in imitation of the real weapon. The designs shown represent original arms of the sixteenth and seventeenth centuries. As they are the genuine reproductions, each article can be labelled with the name, adding to each piece interest and value, says the English Mechanic, London.

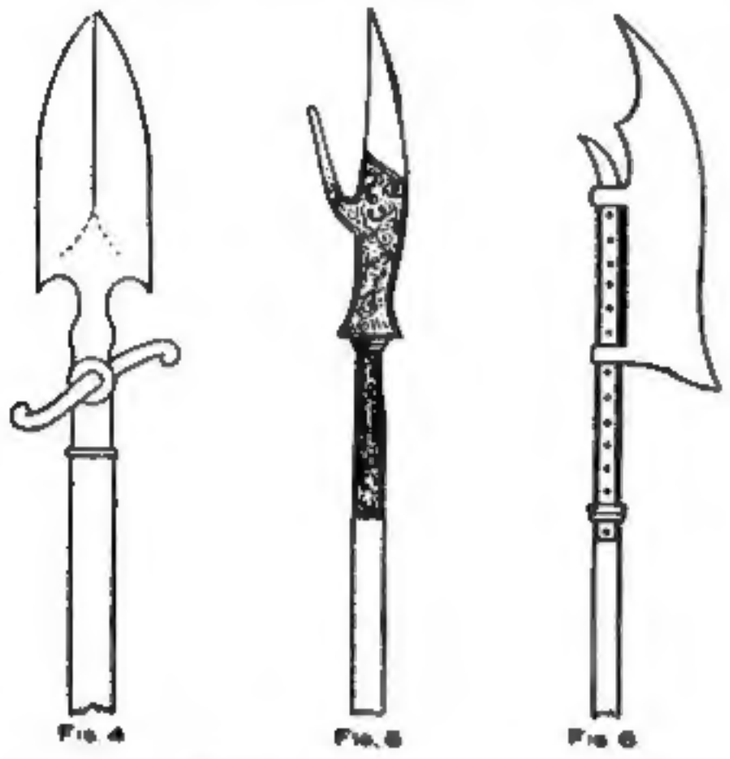
Each weapon is cut from wood. The blades of the axes and the cutting edges of the swords are dressed down and finished with sandpaper and the steel parts represented by covering the wood with tinfoil. When putting on the tinfoil, brush a thin coat of glue on the part to be covered and quickly lay on the foil. If a cutting edge is to be covered the tinfoil on one side of the blade must overlap the edge which is pasted on the opposite side. The other side is then covered with the tinfoil of a size that will not quite cover to the cutting edge. After laying the foil and allowing time for the glue to dry, wipe the surface with light strokes up and down several times using a soft piece of cloth.



Partisan, Fork and Halberd

A French partisan of the sixteenth century is shown in Fig. 1. The

weapon is 6½ ft. long with a round handle having the same circumference for the entire length which is covered with crimson cloth or velvet and studded all over with round-headed



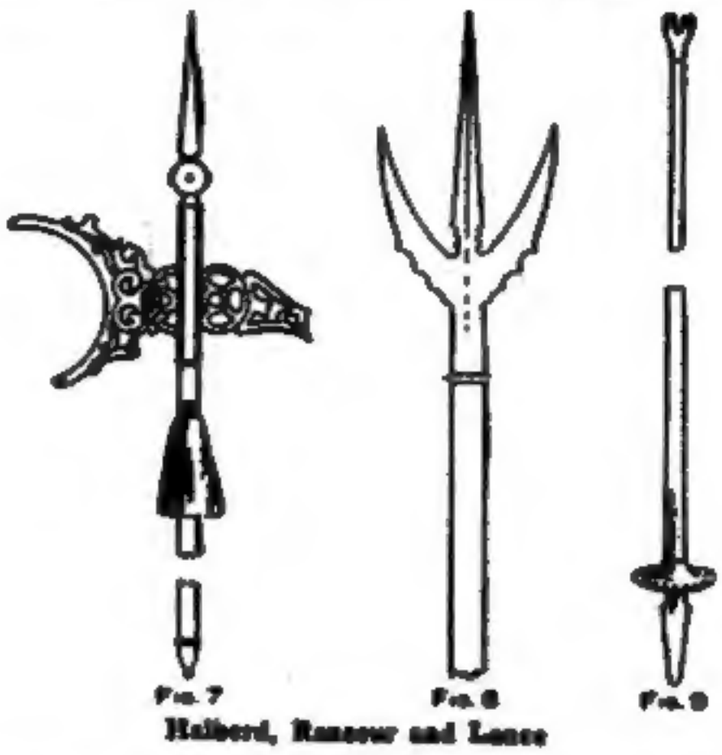
Spontoon, Glaive and Voulge

brass nails. The spear head is of steel about 15 in. long from the point where it is attached to the handle. The widest part of the blade from spear to spear is about 8 in. The length of the tassel or fringe is about 4 in.

Figure 2 shows a German military fork of the sixteenth century, the length of which is about 5 ft. with a handle of wood bound with heavy cord in a spiral form and the whole painted a dark color. The entire length of the fork from the handle to the points is about 10 in., and is covered with tinfoil in imitation of steel.

A Swiss halberd of the sixteenth century is shown in Fig. 3. This combination of an axe and spear is about 7 ft. long from the point of the spear to the end of the handle, which is square. The spear and axe is of steel with a handle of plain dark wood. The holes in the axe can be bored or burned out with red-hot iron rods, the holes being about ¼ in. in diameter.

Figure 4 shows an Austrian officers' spontoon, used about the seventeenth century. It is about 6 ft. long with a round wooden handle. The spear head from its point to where fixed on the handle is about 9 in. long. The edges are sharp. The cross bar which runs through the lower end of the spear can



Halberd, Ranseur and Lance

be made in two pieces and glued into a hole on each side. The length of this bar is about 5 in. The small circular plate through which the bar is fixed can be cut from a piece of cardboard and glued on the wooden spear.

A gisarm or glaive, used by Italians in the sixteenth century, is shown in Fig. 5. The entire length is about 6½ ft. The blade is engraved steel with a length of metal work from the point of the spear to where it joins the handle or staff of about 18 in. It has a round wooden handle painted black or dark brown. The engraved work must be carved in the wood and when putting the tinfoil on, press it well into the carved depressions.

Figure 6 shows a Saxon voulge of the sixteenth century, 6 ft. long, with a round wood handle and a steel axe or blade, sharp on the outer edge and held to the handle by two steel bands, which are a part of the axe. The bands can be made of cardboard and glued on to the wood axe. These bands can be made very strong by reinforcing the cardboard with a piece of canvas. A small curved spear point is carved from a piece of wood, covered with tinfoil and fastened on the end of the handle as shown. The band of metal on the side is cut from cardboard, covered with tinfoil and fastened on with round-headed brass or steel nails.

A very handsome weapon is the German halberd of the sixteenth century which is shown in Fig. 7. The entire length is about 6½ ft., with a round wooden handle fitted at the lower end with a steel ornament. The length of the spear point to the lower end where it joins on to the handle is 14 in. The extreme width of the axe is 16 or 17 in. The outer and inner edges of the crescent-shaped part of the axe are sharp. This axe is cut out with a scroll or keyhole saw and covered with tinfoil.

An Italian ranseur of the sixteenth century is shown in Fig. 8. This weapon is about 6 ft. long with a round staff or handle. The entire length of the metal part from the point of the spear to where it joins the staff is 15 in. The spear is steel, sharp on the outer edges.

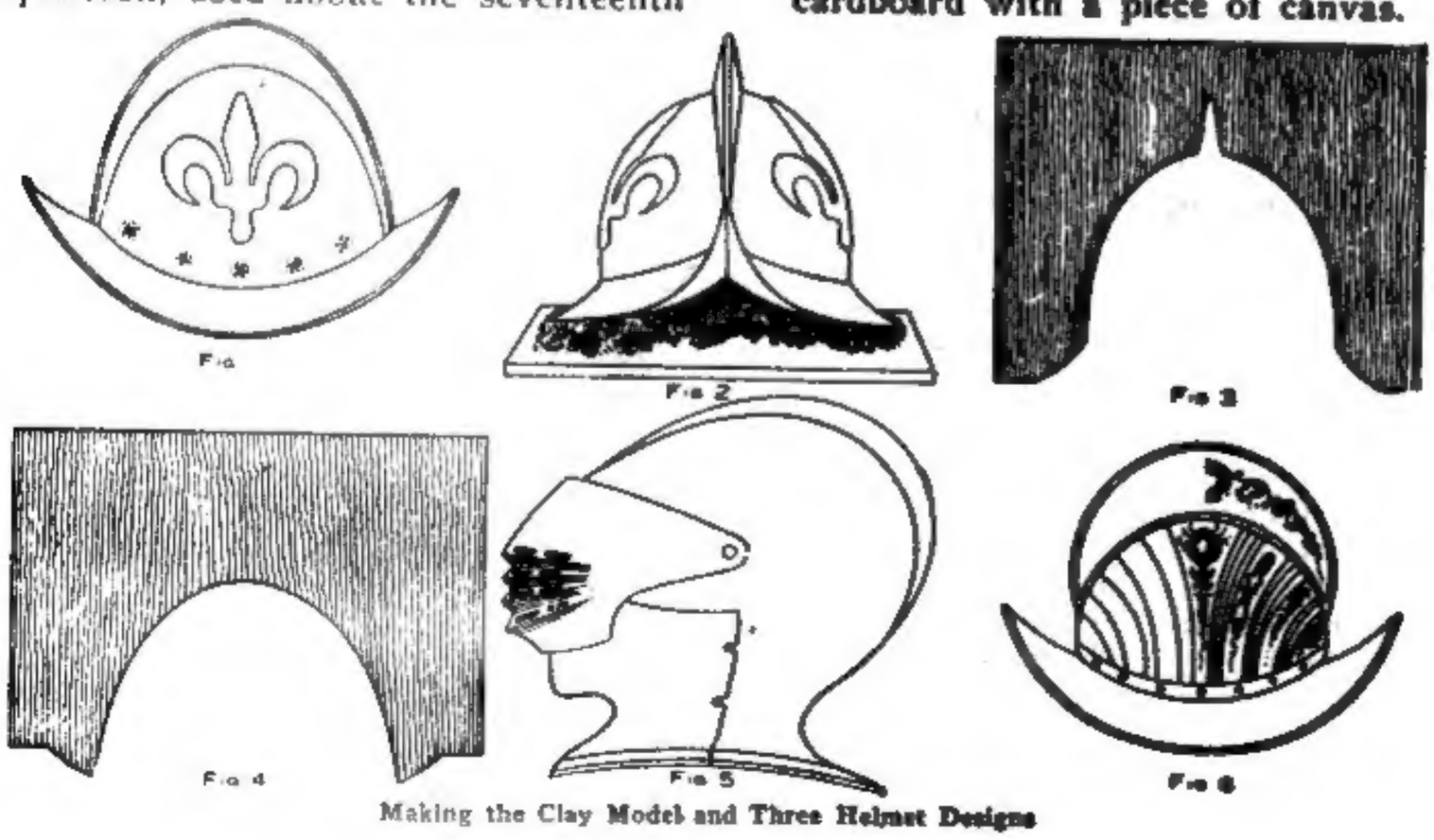
Figure 9 shows a tilting lance with vamplate used in tournaments in the sixteenth century. The wood pole is covered with cloth or painted a dark color. At the end is a four-pronged piece of steel. The vamplate can be made of cardboard covered with tinfoil to represent steel and studded with brass nails. The extreme length is 9 ft.

The tassels or fringe used in decorating the handles can be made from a few inches of worsted fringe, about 4 in. long and wound around the handle or staff twice and fastened with brass-headed nails.

PART V

The preceeding chapters gave descriptions of making arms in imitation of ancient weapons, and now the amateur armorer must have some helmets to add to his collection. There is no limit to the size of the helmet, and it may be made as a model or full sized. In constructing helmets, a mass of clay of any kind that is easily workable and fairly stiff, is necessary, says the English Mechanic, London. It must be kept moist and well kneaded. A large board or several planks, joined closely together, on which to place the clay, will be necessary. The size of this board will depend on the size of the work that is intended to be modeled upon it.

The way to make a helmet is described in the following method of producing a German morion, shown in Fig. 1. This helmet has fleur-de-lis in embossed work, and on each side is a badge of the civic regiment of the city of Munich. The side view of the



Making the Clay Model and Three Helmet Designs

helmet is shown in Fig. 1.

The clay is put on the board and modeled into the shape shown in Fig. 2. This is done with the aid of a pair of compasses, a few clay-modeling tools, and the deft use of the fingers. The fleur-de-lis are slightly raised, as in bas-relief. To aid in getting the helmet in correct proportion on both sides, and over the crest on top, cut out the shape from a piece of wood, as shown in Fig. 3, with a keyhole saw. This wood being passed carefully and firmly over the clay will bring it into shape, and will also show where there may be any deficiencies in the modeling, which can then be easily remedied by adding more clay. The cut-out pattern shown in Fig. 4 is the side outline of the helmet.

Scraps of thin, brown, wrapping paper are put to soak in a basin of water to which has been added about a tablespoonful of size melted and well stirred, or some thin glue, and left over night to soak. The paper should be torn in irregular shapes about as large as the palm of the hand. After the clay model is finished, give it a thin coat of oil—sweet or olive oil will answer the purpose very well. All being ready, the clay model oiled, and the basin of soaked paper near to hand, take up one piece of paper at a time and very carefully place it upon the model, pressing it well on the clay and into and around any crevices and patterns, and continue until the clay is completely covered.

This being done, give the paper a thin and even coating of glue, which must be quite hot and put on as quickly as possible. Put on a second layer of paper as carefully as before, then another coating of glue, and so on, until there are from four to six coats of glue and paper. When dry, the paper coating should be quite stout and strong enough for the helmet to be used for ornamental purposes. Before taking it off the model, which should be no difficult matter, owing to the clay being oiled, trim off any ragged edges of paper with a sharp knife, and smooth and finish all over with some fine sandpaper. The paper is then given a thin coat of glue and sections of tinfoil stuck on to give it a finished appearance. When the helmet is off the model, make holes with a small awl at equal distances, through which to insert some fancy brass nails, bending the points over and flat against the inside of the helmet.

A vizor helmet is shown in Fig. 5. This helmet has a movable vizor in the front that can be lifted up, a crest on top, and around the neck a narrow gorget which rests upon the wearer's shoulders. The whole helmet, with the exception of the vizor, should be modeled and made in one piece. The vizor can then be made and put in place with a brass-headed nail on each side. The oblong slits in front of the vizor must be carefully marked out with a pencil and cut through with a knife or chisel.

In Fig. 6 is shown an Italian casque of a foot soldier of the sixteenth century. This helmet may have the appearance of being richly engraved as shown in one-half of the drawing, or, a few lines running down, as seen in the other part of the sketch, will make it look neat. The band is decorated with brass studs.

An Italian cabasset of the sixteenth century is shown in Fig. 7. This helmet is elaborately decorated with fancy and round-headed nails, as shown in the design.

Fig. 7

In Fig. 8 is shown a large bassinet with a hinged vizor which comes very much forward, so as to allow the wearer to breathe freely. This helmet was worn about the sixteenth century, and was probably used for tilting and tournaments.

A burgonet skull-cap of the seventeenth century is shown in Fig. 9. The vizor is composed of a single bar of metal, square in shape, which slides up and down in an iron socket attached to the front of the helmet, and is held in any position by a thumbscrew as shown in the illustration.

A hole in the peak of the helmet allows it to hang in front of the wearer's face. This contrivance should be made of wood, the helmet to be modeled in three pieces, the skullcap, peak and lobster shell neck guard in one piece, and the ear guards in two pieces, one for each side. The center of the ear guards are perforated. All of the helmets are made in the same manner as described for Fig. 1. They are all covered with tinfoil.

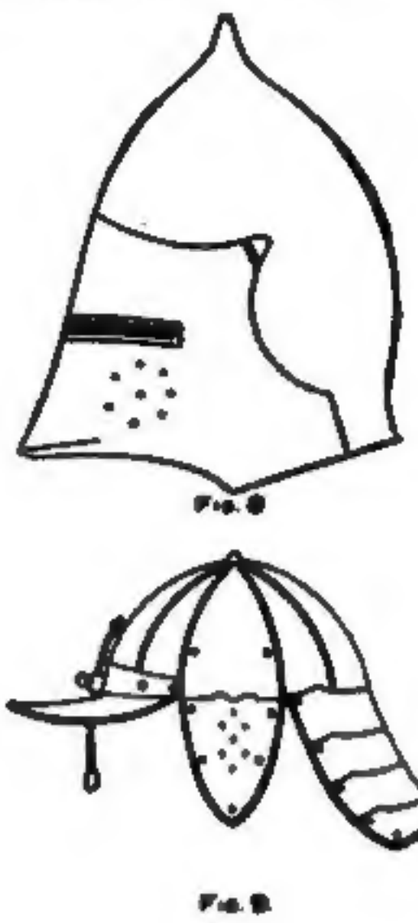


Fig. 8

PART VI

A mass of any kind of clay that is easily modeled and fairly stiff must be prepared and kept moist and well kneaded for making the models over which paper is formed to make the shape of the articles illustrated in these sketches. A modeling board must be made of one large board or several pieces joined closely together upon which to work the clay, says the English Mechanic, London. The size of the board depends upon the size of the work to be made.

An open chamfron of the fifteenth century is shown in Fig. 1. This piece of horse armor, which was used in front of a horse's head, makes a splendid center for a shield on which are fixed the swords, etc., and is a good piece for the amateur armorer to try his hand on in the way of modeling in clay or papier mache work. The opening for the animal to put his head into is semicircular, and the sides do not cover the jaws. As the main part

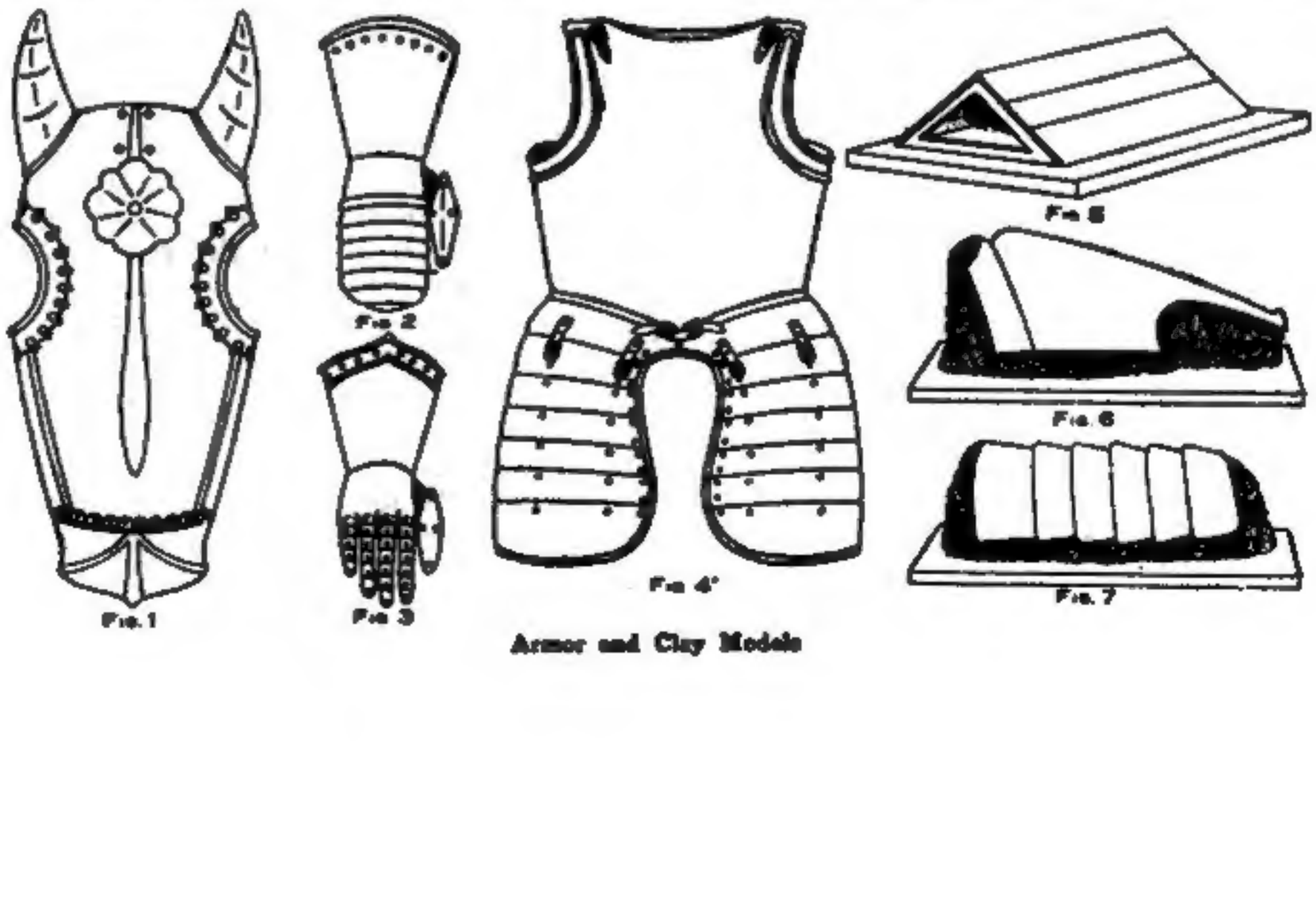


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7

Armor and Clay Models

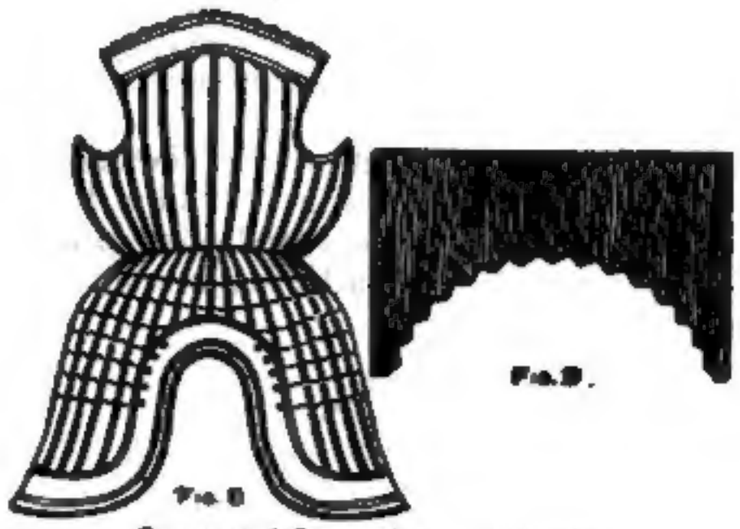
of this armor is worn in front of the head the extreme depth is about 4 in. The entire head piece must be modeled in clay with the hands, after which it is covered with a thin and even coating of sweet or pure olive oil. A day before making the clay model some pieces of thin, brown wrapping paper are torn in irregular shapes to the size of the palm of the hand and put to soak in a basin of water in which a tablespoonful of size has been dissolved. If size cannot be obtained from your local painter, a weak solution of glue will do equally well. All being ready, and the clay model oiled, take up one piece of paper at a time and very carefully place it on the surface of the model, pressing it on well and into and around any crevices and patterns. Continue this operation until the clay model is completely covered on every part. This being done, give the paper a thin and even coating of glue, which must be quite hot and laid on as quickly as possible. Lay on a second layer of paper as carefully as before, then another coat of glue, and so on until there are five or six coats of glue and paper. When this is dry it will be strong enough for all ornamental purposes. The ragged edges of the paper are trimmed off with a sharp knife and the whole surface smoothed with fine sandpaper. Then carefully glue on sections of tinfoil to give the armor the appearance of steel. The armor is now removed from the model.

A mitten gauntlet of the fifteenth century is shown in Fig. 2. This can be made in one piece, with the exception of the thumb shield, which is separate. The thumb shield is attached to the thumb of an old glove which is fastened with round headed nails on the inside of the gauntlet. The part covering the wrist is a circular piece, but the back is not necessary as it would not be seen when the gauntlet is hanging in its place.

In Fig. 3 is shown a gauntlet of the seventeenth century with separately articulated fingers. This gauntlet may be molded in one piece, except the thumb and fingers, which must be made separately and fastened with the thumb shield to the leather glove that is attached to the inside of the gauntlet, the same as in Fig. 2.

A breastplate and tassets of the sixteenth century are shown in Fig. 4. The tassets are separate and attached to the front plate with straps and buckles, as shown in the sketch. There is a belt around the waist which helps to hold the back plate on. Attached to the back of the plate would be two short straps at the shoulder. These are passed through the buckles shown at the top right and left-hand corners of the front plate. For decorative purposes the back plate need not be made, and therefore it is not described. The method of making armor is the same as of making helmets, but as larger pieces are formed it is well to use less clay owing to the bulk and weight.

An arrangement is shown in Fig. 5 to reduce the amount of clay used. This triangular-shaped support, which



Corrugated Breastplate and Former

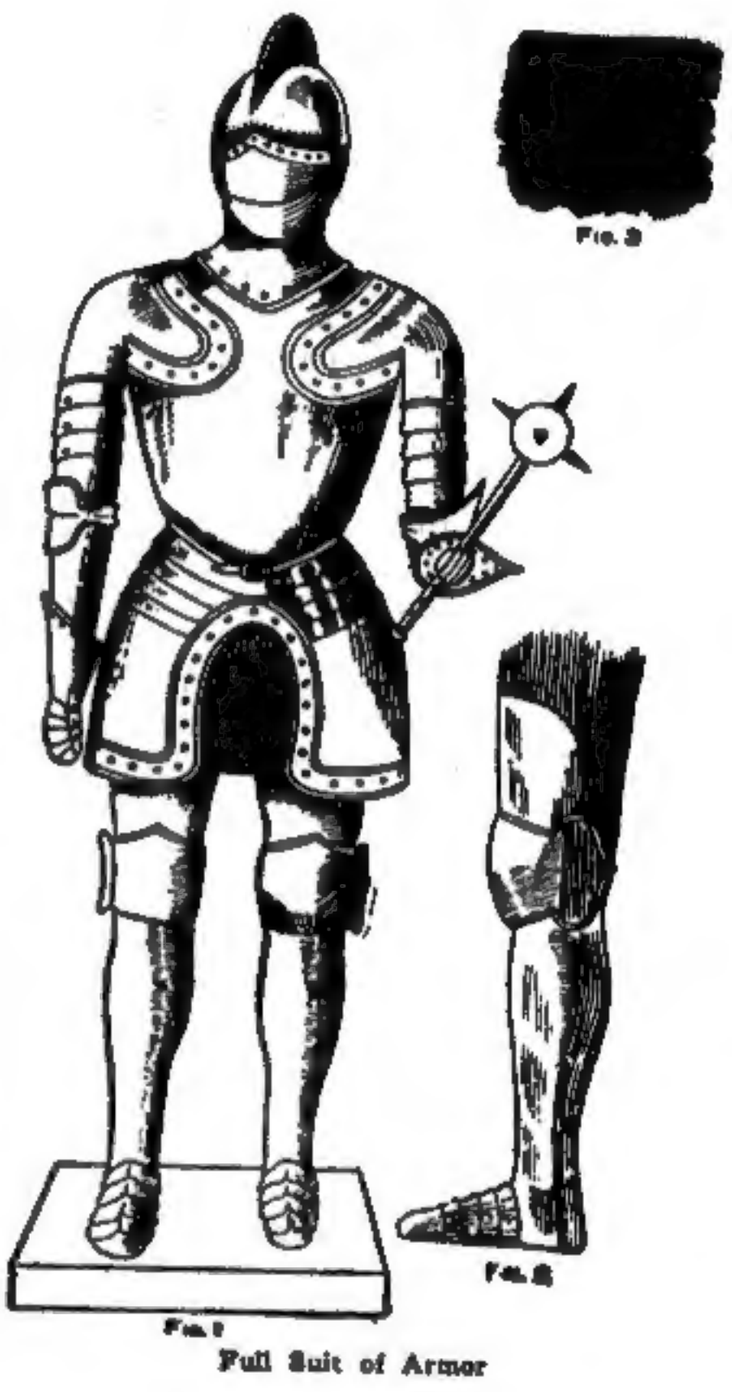
can be made in any size, is placed on the modeling board or bench and covered with clay. This will make the model light and easy to move around, and will require less clay. It is not necessary to have smooth boards; the rougher the better, as the surface will hold the clay. The clay forms modeled up ready to receive the patches of brown paper on the surface are shown in Figs. 6 and 7.

A German fluted armor used at the beginning of the sixteenth century is shown in Fig. 8. The breastplate and tassets of this armor are supposed to be in one piece, but for convenience in making it will be found best to make them separately and then glue them together after they are taken from the model. A narrow leather belt placed around the armor will cover the joint. Fluted armor takes its name from a series of corrugated grooves, ½ in. in depth, running down the plate. A piece of board, cut into the shape shown in Fig. 9, will be very useful for marking out the fluted lines.

PART VII

The helmets, breastplates and gauntlets described in parts V and VI can be used in making up a complete model for a full suit of armor of any size, as shown in Fig. 1. All of the parts for the armor have been described, except that for the legs. Figure 2 shows how the armor is modeled on the side of the left leg. The clay is modeled as described in previous chapters, the paper covering put on, and the tinfoil applied in imitation of steel. The chain mail seen between and behind the tassets is made by sewing small steel rings on a piece of cloth as shown in Fig. 3. These rings may be purchased at a hardware store or harness shop.

The whole figure when completed is placed on a square box covered with red or green baize. The armor should be supported by a light frame of wood built up on the inside, says the English Mechanic, London. Two vertical pieces are firmly attached to the box so they will extend up inside the legs, and at the top of them is attached a crosspiece on which is placed a vertical stick high enough to carry the helmet. The two lower pieces must be built up and padded out with straw, then covered with red cloth or baize to represent the legs.



Full Suit of Armor

In making up the various pieces for a full model it will be found very convenient to use rope, a stout cord or strings in making up the patterns on the parts. Instead of using brass-headed nails, brass paper fasteners will be found useful. These can be purchased at a stationery store. Secure the kind having a round brass head from which hang two brass tongues. These are pushed through a hole and spread out flat on the opposite side. Other materials can be used in the place of tinfoil to represent steel. Silver paper will do very well, but if either the tinfoil or silver paper are found difficult to manipulate, go over the armor with a coat of silver paint put on with a brush. When dry give the surface a coat of varnish.

Mines and Booby Traps

Department of Navy — 1969

ENEMY MINE WARFARE

INTRODUCTION

The history of mine and boobytrap warfare is almost as long as the history of war itself. Although these devices were once considered an unfair and cowardly manner of fighting an enemy, nations continued to develop and employ mines and boobytraps because they provided an effective and simple means of inflicting casualties upon an enemy force.

During the war with France, 1946-1954, the Viet Minh used improvised explosive mines and boobytraps effectively against the French forces. The VC/NVA have continued to improve upon these techniques and are employing mines and boobytraps as an effective weapons system against free world military forces in SVN today. The number of Marine casualties, perhaps better than any other example, illustrates how effective the enemy is with these devices. Marines landed in force in SVN during March 1965 and during the first months of fighting approximately 65-75 percent of all Marine casualties were caused by mines and boobytraps. Much has been learned about the enemy's methods of employing mines and boobytraps since March 1965, but despite this knowledge, Marines, at an alarming rate, continue to become casualties as a direct result of enemy mines and boobytraps. During 1968, 37.7 percent of all Marine casualties were caused by the accidential detonation of a mine or boobytrap. In other words, more than one of every three Marines killed or wounded in SVN becomes a casualty as the result of a mine or boobytrap. Although a great many detection means, ranging from intricate electronic devices to specially trained dogs, have been developed, experience has shown that an alert Marine, aware of what to look for and where to look, is the most effective detection device.

ENEMY DOCTRINE

Although modified by past guerrilla warfare experience in Vietnam, VC/NVA mine warfare doctrine continues to closely parallel that of the Chinese Communist Army. Extensive deliberate minefields have not been encountered in Vietnam. Rather, the enemy employs mines singly or in clusters to achieve his purposes.

In areas occupied and protected by free world forces, the enemy employs mines to delay and disrupt the use of roads and paths and to cause the allies to divert forces to guard and clear those routes. In addition to the threat to military traffic and lawful civilian movement, the free world personnel and equipment employed in patrolling the roads and in detecting and removing mines are prime targets.

In contested areas where friendly offensive operations or patrol activities are conducted, the enemy employs mines and boobytraps to inflict casualties, delay and channelize movement, and damage or destroy equipment.

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ENEMY SOURCES OF SUPPLY

The enemy uses a very limited number of modern machine-produced mines. The majority of enemy mines are handmade by the VC using U.S. duds, discarded ammunition and equipment, and materials thrown away by U.S. forces as trash. Ninety percent of all the material in enemy mines and boobytraps is of U.S. origin (see fig.1). Of all the explosive devices produced locally in VC mine factories, 95 percent are antipersonnel boobytraps.

All dud ammunition is a source of enemy supply. After airstrikes and artillery and mortar missions, enemy salvage teams make sweeps to collect duds. Lighter ordnance is carried away to preparation areas; large bombs and projectiles are broken down and stripped on the spot. In some cases the larger duds are rigged as boobytraps where they have fallen. This is especially true when the enemy feels the strike or fire mission was a preparation for an infantry attack.

Figure 1.--Enemy equipment captured by Marines on sweep operations in ICTZ. Note US M-26 grenade in center of picture. Other grenades are locally produced using C-ration cans.

However, dud ammunition is not the only source of enemy supply. Carelessly discarded ordnance of all sizes and in any quantity is collected by enemy salvage teams. Mortar rounds, rockets, LAAW's, grenades, and small arms ammunition abandoned to lighten the load (or improperly secured and lost by fast-moving Marines) have value as the explosive element in boobytraps. Even a single M16 round ejected to clear a stoppage can be used by the enemy.

Additionally, materials discarded as trash and improperly destroyed such as ration, ammunition, beer and soda cans, batteries, waterproof packaging materials, bandoliers, etc., provide the enemy a valuable source of supply to support his mine warfare operations. These items have, on numerous instances, been employed successfully against Marines and their equipment. Thorough police of friendly

positions upon departure and complete destruction of trash are mandatory to deny the enemy this source of supply.

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VC MINE FACTORIES

Primitive VC mine factories are usually located in the areas they supply. Great care is taken in the camouflage and dispersal of these facilities. Usually constructed underground, effort is made to disperse the workshops and storage throughout a series of tunnels. These limit destruction by working accidents or free world force artillery, air and naval gunfire and protect against discovery. As important as concealment of the mine factory, is the mobility of its personnel and equipment. Even while the mine factory is being settled in one position, new positions are being prepared for rapid displacement. Rarely does a mine factory remain in one place any longer than a few weeks. There is no distinct pattern of movement. Factories have been known to return to previous positions even after that position has been discovered and destroyed by Marine forces.

NVA-trained engineers provide the skilled nucleus for the enemy mine factories, but supervision and labor are primarily VC. The typical output of a local VC mine factory is about 135 mines and explosive devices per month.

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ENEMY TACTICS

ANTITANK AND ANTIVEHICULAR MINING

As we improve in our ability to detect mines, the enemy counters with new twists such as increased use of boobytraps attached to a basic mine to create casualties among mine-clearing personnel; larger mines buried deeper with reduced activation pressure; and pressure electric detonators with offset devices to explode mines under vehicles. Command-detonating mines are normally used in densely populated areas and pressure-type devices in less populated sections. The heaviest mining is along lines of communications near fixed installations.

The enemy makes every effort to avoid repeating practices which, when analyzed, could indicate a pattern. Therefore, the VC/NVA doctrine stresses where to use mines, not how. Listed below are a few of the kinds of places where enemy antitank and antivehicular mines may be found:

- Road junctions and the areas in the vicinity of the road near the junction, with all the mines set to detonate simultaneously.
- Bridges and the approaches 5 to 15 meters from the bridges.
- Old wheel and tread tracks in the road, with care taken to duplicate the track after mine emplacement.
- Underneath roads, tunneling in from the shoulders.
- Potholes in the road.
- Areas recently cleared by free world military forces. The enemy replaces the mines that have been taken out.

ANTIPERSONNEL MINES AND BOOBYTRAPS

Enemy tactics in emplacing antipersonnel mines and boobytraps differ from those used in antitank and antivehicular mining only by where they put them. Locations most commonly used by the VC/NVA to emplace antipersonnel mines and boobytraps are:

- Narrow passages.
- Paddy dikes.
- Trail junctions.
- Hedgerows and tree lines.
- Tunnels and caves.
- Fence lines and gates.
- Tree branches overhanging trails.
- Likely CP sites.
- High ground and ridgelines.
- Shady areas.
- Stream fords.
- Wells and natural watering points on streams and rivers.
- Likely helicopter landing zones.

Remember: Any place a Marine frequently walks, takes cover, rests, or draws water is a likely location for enemy antipersonnel mines and boobytraps.

Physical Protective Countermeasures

The individual Marine can take these steps to reduce the effectiveness of enemy mines:

- Wear body armor and helmet.
- Sandbag vehicle flooring. When possible, place a heavy rubber mat over sandbags to reduce secondary fragments such as shrapnel, sand, stones and pieces of sandbag.
- Keep arms and legs inside vehicles to achieve maximum protection from sandbags.
- Maintain proper distance from other personnel.
- Don't travel alone.
- Don't pick up or touch what appear to be attractive "souvenirs". The VC/NVA prey upon the natural curiosity of Marines and their desire to take home a souvenir.

Beware: That "souvenir" is most likely a boobytrap.

Detection Countermeasures

Once emplaced, a mine or boobytrap must be found before it causes multiple casualties through accidental detonation by a Marine. Unfortunately, too many boobytraps are discovered only after they explode. It is imperative that detection techniques be stressed. Detection may be by:

- Visual inspection. At present, the best mine and boobytrap detector in the Marine Corps is an alert and observant Marine. Each Marine must know the areas in which boobytraps and mines are normally found and be alert for things which "just don't look right." Examples are:
- Mud smears, mudballs, dung, or a board on the road.
- Apparent road repair, new fill or paving patches, ditching or culvert work.
- Wires leading away from the side of the road.

•Tripwires across the trails; along shoulders of roads at likely ambush sites; across the most accessible route through dense vegetation; at fords, ditches and across rice paddy dikes.

•Terrain features which do not appear natural. Cut vegetation dries and changes color; rain may wash away covering material and cause an explosive device to sink leaving a surface depression; a covered device may appear as a mound.

•Suspicious items in trees, branches, or bushes.

•Markings used by VC/NVA to indicate the location of a mine or boobytrap.

● Probing. Suspicious spots must be carefully probed with a probe or bayonet.

● Mine detectors. Mine detectors are designed to assist the individual Marine in a detailed, deliberate sweep of a specific area, usually a road. Particular attention must be given to the time factors of the individual sweeping situation, since overhasty opening of a road can mean an ineffective sweep and quite possibly destruction or injury to vehicular traffic and personnel. The average sweep rate varies from almost nothing to about 5 m.p.h. depending, of course, on the proficiency of the team and the number of contacts encountered. In using detectors, certain considerations must be kept in mind:

•Graveled roads make it difficult for the AN/PRS-4 detector to discriminate between real and false targets.

•Metallic debris, such as can tops, small arms ammunition cases, and metal fragments from artillery rounds fired over roads at night to discourage mine laying, make it difficult for the AN/P153 detector to discriminate between real and false targets.

•The tendency for the enemy to bury mines deeper than designed detection depths, and to deliberately plant metallic debris in the road, calls for additional caution in the use of detectors.

•Operator fatigue. Consideration must be given to the fatigue experienced by operators after 20 minutes of wearing detector earphones. This condition can be delayed to 1 or 2 hours by wearing earphones over the helmet so that 2 to 4 inches exist between ear and phone. This also permits the operator to hear a verbal alert for an ambush.

●Use of the Buddy System. This system is not only useful in training inexperienced Marines, but also provides an extra margin of safety to the individuals who employ it. Two Marines working together, in the same area, have the advantage of increased detection capability, mutual reassurance, and shared knowledge.

◊ Destruction Countermeasures

Once detected, mines and boobytraps must be marked and/or destroyed in place by the discovering person or unit to prevent accidential detonation by a following unit or individual Marine. Considerations for destruction are:

•Mines and boobytraps should not be moved unless absolutely necessary and then only by qualified EOD or engineer personnel. Many boobytraps are themselves boobytrapped, and if disturbed will detonate the associated device.

•Explosive devices should be destroyed by engineers. If engineers are not available, then devices may be destroyed by selected qualified personnel within each unit.

•Mines and boobytraps may be destroyed or neutralized by use of grappling hooks, demolitions, and artillery fires. The LVTE linecharge and the LVTE with plow-shaped mine excavator (figs. 5 and 6) should be considered for use in areas of high mine density.

◊ Avoidance Countermeasures

Strict application of training and careful planning of movements through danger areas will enable unit commanders and individuals to reduce casualties by simply avoiding the explosive devices. The unit leader must analyze from the enemy's viewpoint each area through which he intends to move his men. He must ask himself the question, "If I were the enemy, where would I put the boobytrap?" This question can and should influence both administrative and tactical movements and is a factor to be considered in the scheme of maneuver during an attack. Some suggested means for avoiding mines and boobytraps are:

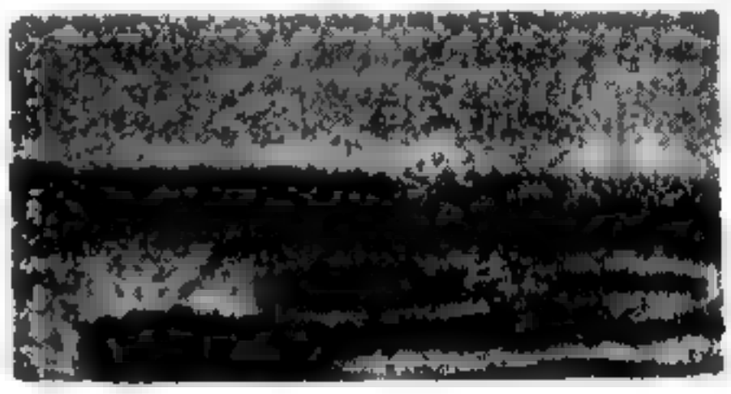

Figure 5.--The LVTE firing its organic linecharge to clear mines.

Figure 6.--The LVTE with its plow-shaped mine excavator.

•Stay off trails, footpaths, cart tracks, or other likely routes of travel as much as possible. Vary routes used to villages and key terrain features. Use of the same route twice is an invitation to the enemy to employ boobytraps. Keep the VC/NVA guessing as to which route will be used next.

•Move where local inhabitants move. These people know the location of most

mines and boobytraps and will avoid these areas. In a village, stay near the villagers and watch which buildings they use. Use Vietnamese as guides whenever possible. Have sufficient money on hand to pay for information on mine and boobytrap locations and support VIP.

•Avoid patterns. Constantly change direction of movement. Check times of departure and return of patrols to ensure, for example, that all daylight patrols don't return before supper and all nighttime patrols depart after supper. Avoid the repeated use of the same bivouac areas.

•Maintain intervals of 15 meters between men and 100 meters between men and tracked vehicles. In view of the fact that the effective casualty radius of the M26 grenade is 15 meters, and that two or more casualties are suffered for each boobytrap grenade accidently detonated, the maintenance of proper interval is <u>most</u> important.

•Move slowly. Rapid movement generates carelessness. A unit must be allowed sufficient time to move to its objective.

•At times the enemy will show themselves only when they want to be seen. When pursuing tne enemy, be especially alert for deliberately emplaced boobytraps on the axis of advance.

•Artillery and mortar fires near and in the area of operations will not only discourage boobytrap emplacement, but will also neutralize devices by sympathetic detonation, overturning and burying emplaced mines, and rupturing tripwires. Employment of these fires beside a road, before and during a road sweep, will discourage command detonation of road mines.

•At all times, a lightweight stick (bamboo) or a slender steel rod can be helpful if used to feel for tripwires.

•Mark detected mines and boobytraps so those following may avoid them.

•Helicopters can be used to extract a unit which finds itself in a heavily boobytrapped area.

•At times, the flanks of a road are boobytrapped out to 250 meters as an obstacle to road sweep security teams. Tanks, preceding the infantry, can detonate these boobytraps. When trafficability permits, tanks moving off and parallel to the road sweeps can also reduce tank road-mining incidents. Random selection of tank travel between road and adjacent terrain will keep the NVA guessing as to the actual route the tank will take.

•When on roads, stay in the well-used portion and off shoulders.

•Follow the tracks of the vehicle ahead. If there is no vehicle ahead, stay out of the ruts.

•Avoid holes, depressions, and objects lying on the road.

◆<u>Remember</u>: A boobytrap too easily detected can be a ruse resulting in detonation of other explosive devices emplaced nearby.

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<u>Immediate Action To Take When and After an Explosive Device Is Tripped</u>

It is recognized that little reaction time exists once the detonation chain starts. The maximum delay for the M26 and foreign grenades ranges from 4 to 9 seconds If the delay element has been modified, the minimum fuse delay can be less than 1 1/2 seconds. However, since the time available cannot be predicted, certain immediate action can assist in reducing casualties and the degree of personal injury.

◊ <u>Immediate Action</u>

FIRST: Be alert for the "pop" of the exploding cap, the tug of the tripwire, or the warning of another Marine.

SECOND: Sound a warning so that others may take cover.

THIRD: Drop to the ground immediately.

Immediate action is designed as an instinctive reaction based on minimum fuse delay. When using it also remember:

•Do not attempt to outrun the explosion. The 800 fragments of the M26 grenade have an initial velocity of over 5000 feet per second. During the available delay, however brief, an individual can best remove himself from the cone of the explosion by dropping to the ground. He <u>must</u> assume a minimum delay in every case.

•If possible, when dropping to the ground, present the smallest target to the force of the explosion by pointing the feet in the direction of the charge.

•All those nearby should drop to the ground when the warning is sounded.

•Do not immediately rush to the aid of Marines wounded by mines or boobytraps. Frequently there is a second boobytrap in the vicinity of the first. The man nearest each casualty should carefully clear his way to the wounded individual and render first aid. Under no circumstances should the unit leaders or others crowd near the wounded men.

•Conduct a brief but careful search for other explosive devices in the immediate vicinity before moving on.

•If a device is tripped and does not explode, follow the same immediate action and then blow it in place.

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<u>UNIT TRAINING</u>

We have discussed preventive countermeasures, tactical countermeasures and individual countermeasures. Simply realizing that these countermeasures exist isn't sufficient. It is imperative that every Marine becomes knowledgeable of and proficient in the execution of the countermeasures discussed. This task can be accomplished through an aggressive and comprehensive unit and individual training program. Such training should emphasize:

•Wearing of helmets and body armor.
•Dispersion between men.
•Alertness.
•Visual detection techniques.
•Operation of electronic detection equipment.
•Demolition training which enables Marines to destroy explosive devices in place.
•Employment of the buddy system.

- Avoidance of patterns.
- Immediate action procedures and action to take subsequent to the detonation of an explosive device.

SECTION III

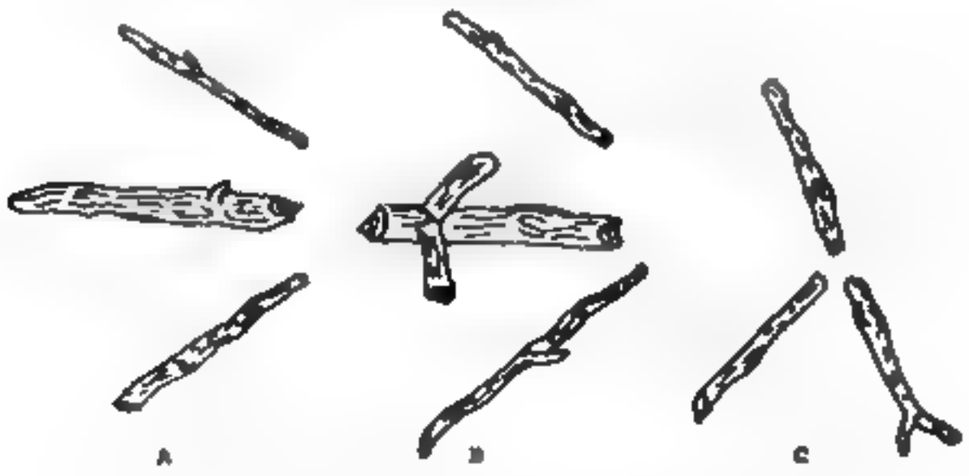
ENEMY MINE INDICATORS

If the enemy emplaces mines or booby-traps in the vicinity of villages or in areas where he moves or expects to move, he often indicates the location or direction of the explosive devices in some manner. The VC/NVA may not always follow the examples in this publication in absolute detail, but as a general rule, the indicators are usually found in a regular pattern such as sticks or stones in a line or sticks placed on or in the ground. This regularity of pattern is the danger signal (see fig. 7). Any arrangement of sticks and stones which appears unnatural indicates a strong possibility of the presence of

Figure 7.--Note the row of rocks on top of bridge beam at the foot of the bridge. This is typical of the warning signs used by the VC/NVA to warn of their mining activities.

mines and boobytraps. The illustrations which follow are examples of marking patterns indicating the presence of mines and boobytraps which have been encountered thus far in SVN.

ARROW MARKERS

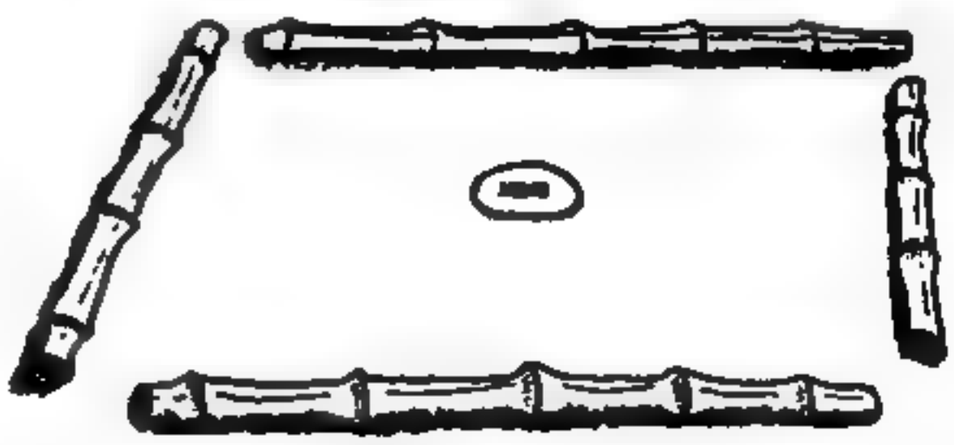


A. Three sticks are placed on the trail in the form of an arrowhead. The important thing to remember is that the point of the arrow does not always point in the direction of the boobytrap. The symbol can only be considered as a means to identify an area as being boobytrapped.

B. A variation of the three-stick arrowhead shows a fourth stick. Again, no definite pattern has been established as to direction or the reason for the fourth stick (usually broken). But it does mean boobytraps in the area.

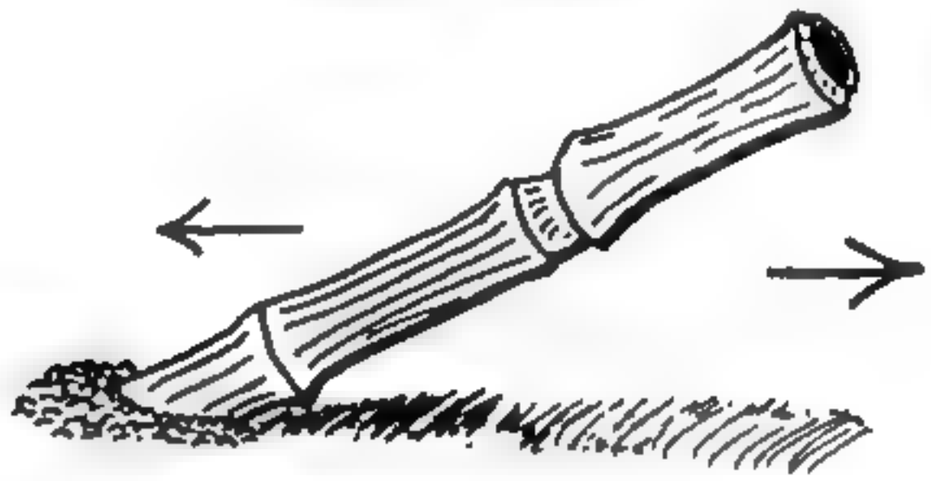
C. The "Y" arrangement is sometimes found farther down the trail from the arrowhead indicating the limit of the danger area. No pattern or specific distance has been established.

BAMBOO RECTANGLE MARKER



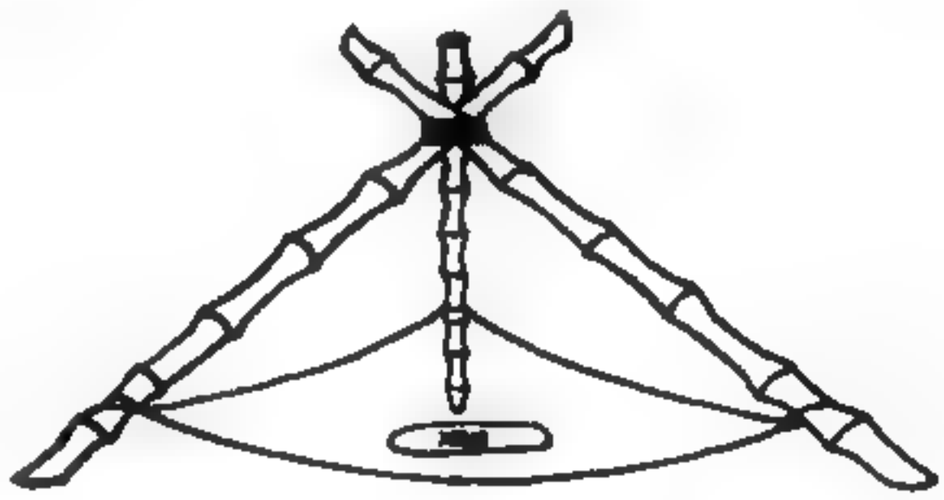
As shown, this marker usually indicates a boobytrap within the square. Most of these symbols found have been laid out with bamboo 18 to 42 inches in length.

BAMBOO MARKER



A piece of bamboo 6 to 8 inches long is stuck in the ground at an angle of 45 degrees. Generally, boobytraps can be expected along the axis of the bamboo in either direction.

BAMBOO TRIPOD MARKER



The bamboo tripod consists of bamboo, usually about 18 inches long, tied together to form a tripod. Wire, vines, cord or string is wrapped around the legs near the bottom to hold the tripod in place. This device has been found directly over punji pits, boobytraps, and mines.

BROKEN BUSH OR STICK MARKERS

A. The enemy has been known to break the tops of small saplings and bushes pointing the broken part in the direction of the boobytrapped area. Usually mines and boobytraps are planted 50 to 100 meters from this marker.
B. A stick or length of bamboo broken at a right angle and lying across the road or trail may mean an enemy mine or boobytrap 200 to 400 meters ahead.

BANANA LEAF MARKERS

A banana leaf or other similar leaf is folded down the center with a thin stick approximately the thickness of a toothpick woven through in two places. In addition to marking mines, this may indicate an ambush area. There is no pattern as to location or distance of mines or ambushes from this marker.

PARALLEL STICK MARKER

Short sticks or lengths of bamboo laid parallel to a road or trail usually mean the road or trail is free of mines or boobytraps.

GROWING GRASS MARKER

Growing grass is sometimes tied to form four growing sheaves of grass. The tied sheaves form a square of about 6 feet. The mine is buried or concealed in the center of the square.

TRAIL MARKERS

These devices have been used extensively together. The mine or boobytrap is placed (buried) under two large leaves. In front and to the rear, at no special distance, stakes are driven. The markers have also been used independently of each other at times.

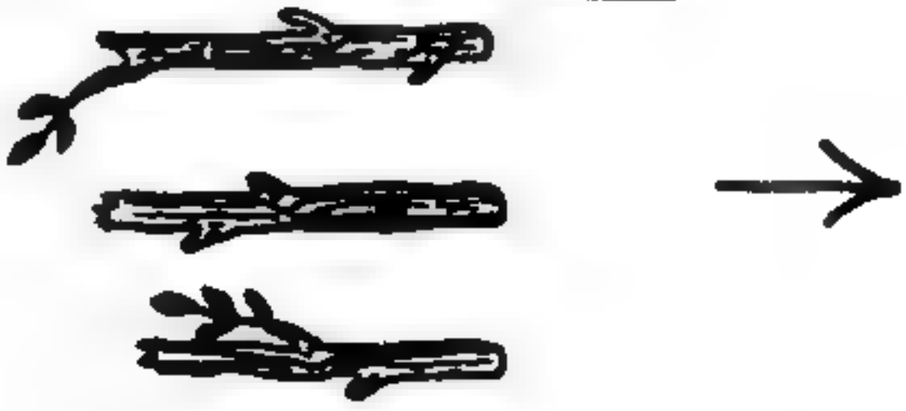
FORKED-STICK MARKER

A forked stick is driven vertically into the ground and another stick is laid into the fork with the elevated end pointing to the danger area. Distance to explosive device is unknown. This sign may also indicate enemy direction of movement.

ROCK MARKERS

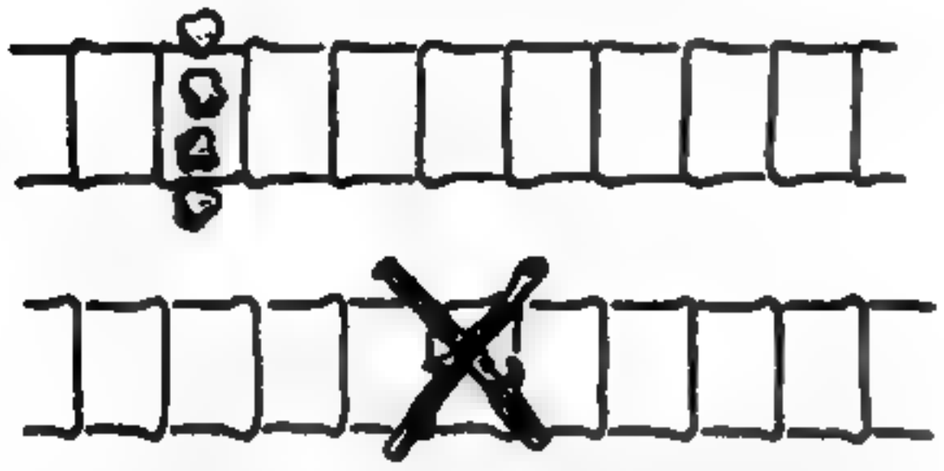
Various formations of rocks and small stones are used to mark boobytrapped areas. No pattern of distance or location has been established.

SPACED-STICK MARKER



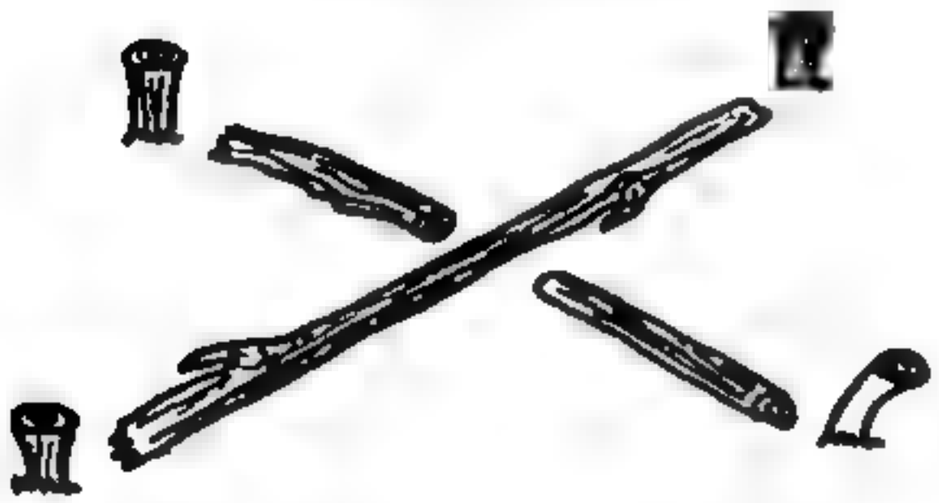
Three sticks, one on each side of a road or trail and one in the middle, usually mean the road is not to be used. A mine or boobytrap is usually 200 to 400 meters from the marker. Stones have been used in the same manner.

TRACK MARKER



The enemy has capitalized on our habit of following old vehicle tracks by placing mines in these tracks. Mines are sometimes marked with crossed sticks or an arrangement of stones. The location of the mine in relation to these markers is unknown. The mine may be under the marker or up to 400 meters farther on.

STAKES WITH X-MARKER



An M1A1 antitank mine with approximately 25 pounds of TNT was discovered under this marker. The mine had been marked with stakes at each corner and three sticks forming an "X" over the mine.

ENEMY MINES AND BOOBYTRAPS

EXPLOSIVE ANTIPERSONNEL DEVICES

Mines and explosive boobytraps employed by the enemy against friendly personnel are limited in type and quantity only by the availability of explosive materials and the imagination of the enemy. Anything that can be made to explode and cause injury can be rigged as an antipersonnel mine or boobytrap.

Antipersonnel mines and explosive boobytraps are very successfully employed by the VC/NVA. Part of this success is because Marines are not familiar with the physical description of explosive devices normally employed by the VC/NVA, and thus fail to recognize them prior to accidental detonation.

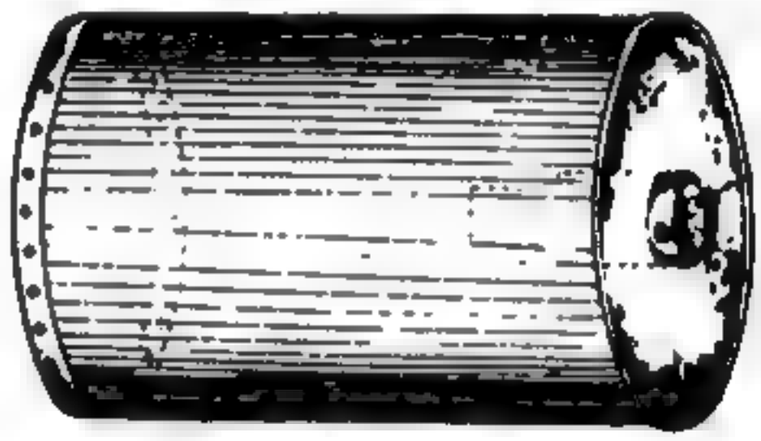
The following illustrations represent some of the devices employed by the VC/NVA in SVN.

MUDBALL MINE

The mudball mine consists of a handgrenade encased in sun-baked mud or clay. The safety pin (pull ring) is removed and mud is molded around the grenade. After the mud dries it holds the lever

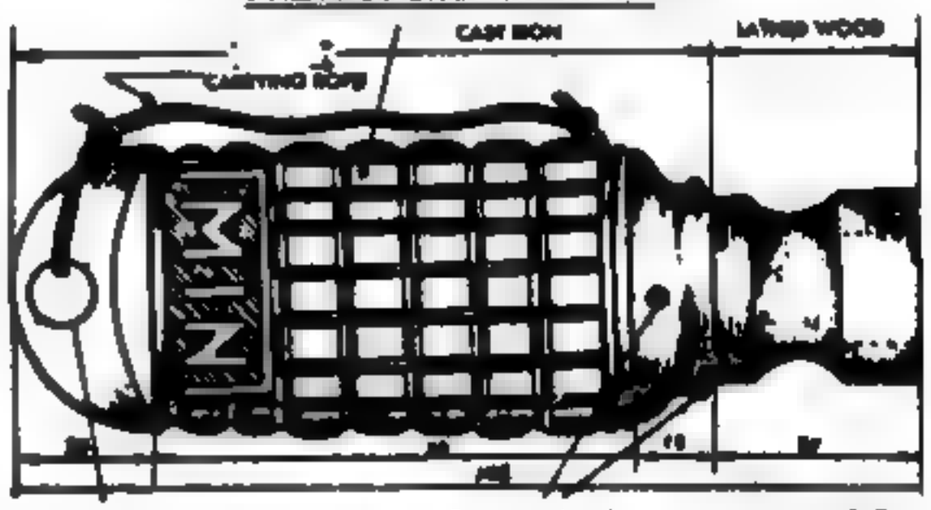
of the grenade in the safe position. The mudball is placed on trails or anywhere troops may walk. Stepping on the ball breaks the dried mud apart and releases the lever detonating the grenade. The U.S. M26 and M33 handgrenades have been the most commonly used grenades for this purpose although other lever-type grenades may be used.

TIN CAN ANTIPERSONNEL MINE



The tin can mine is constructed from sheet metal or any discarded metal container (C-ration, beer, or soft drink can). The firing device for the explosive is an improvised fuse with zero delay action. A handgrenade fuse may be used by removal of the delay element. The mine functions by a tripwire attached to the pull ring. Pressure on the tripwire pulls the pull ring, activating the mine in the same manner as a handgrenade.

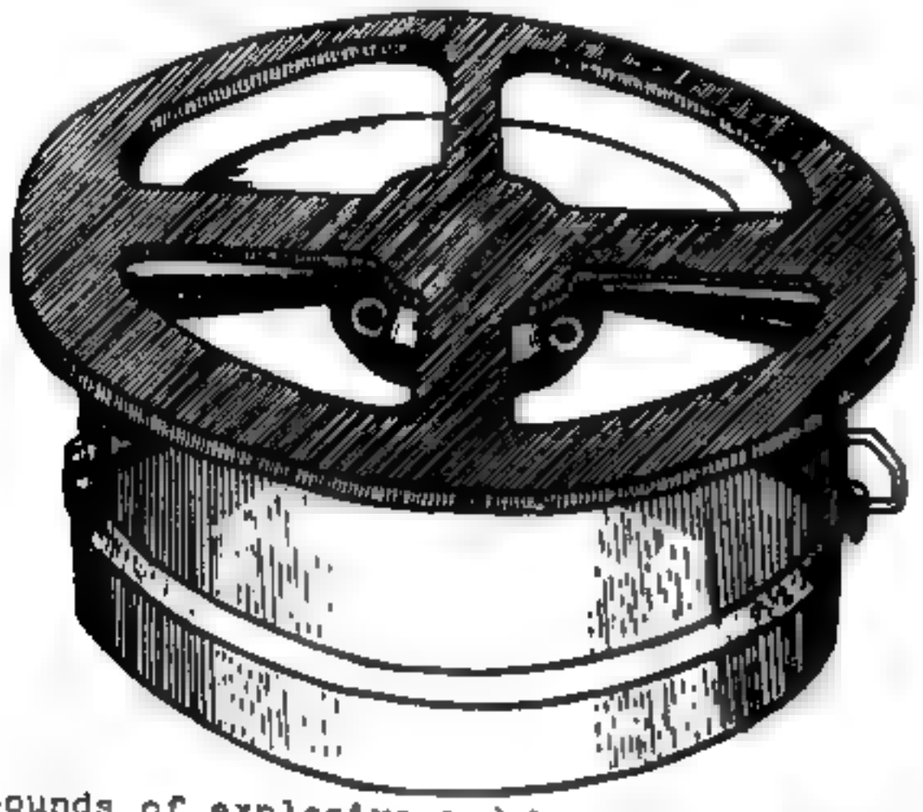
CAST-IRON ANTIPERSONNEL FRAGMENTATION MINE



This mine, made of cast iron, resembles a stick handgrenade with a very short handle. The word "MIN" is often found cast into the body. The handle houses a pull-friction igniter. A tug on a tripwire attached to the friction igniter will activate the fuse.

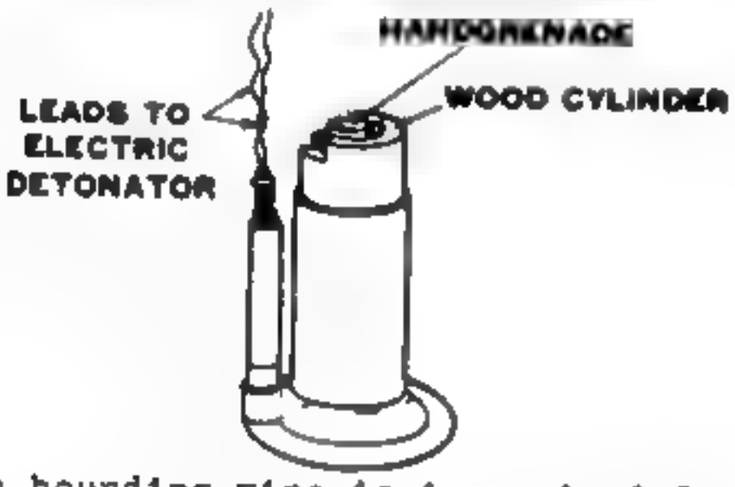
CHINESE COMMUNIST NO. 8 DUAL-PURPOSE MINE

Almost identical to the CHICOM No. 4 Dual-Purpose Mine, this device also has a double-acting fuse. Like the No.4, a pressure of 300 pounds on the pressure spider or a pull of 10 pounds on an attached tripwire will detonate the mine. Slightly larger than the No.4, this mine contains 5



pounds of explosive and has an overall weight of 12 pounds. It is made of metal and coated with creosote for waterproofing.

BOUNDING FRAGMENTATION MINE



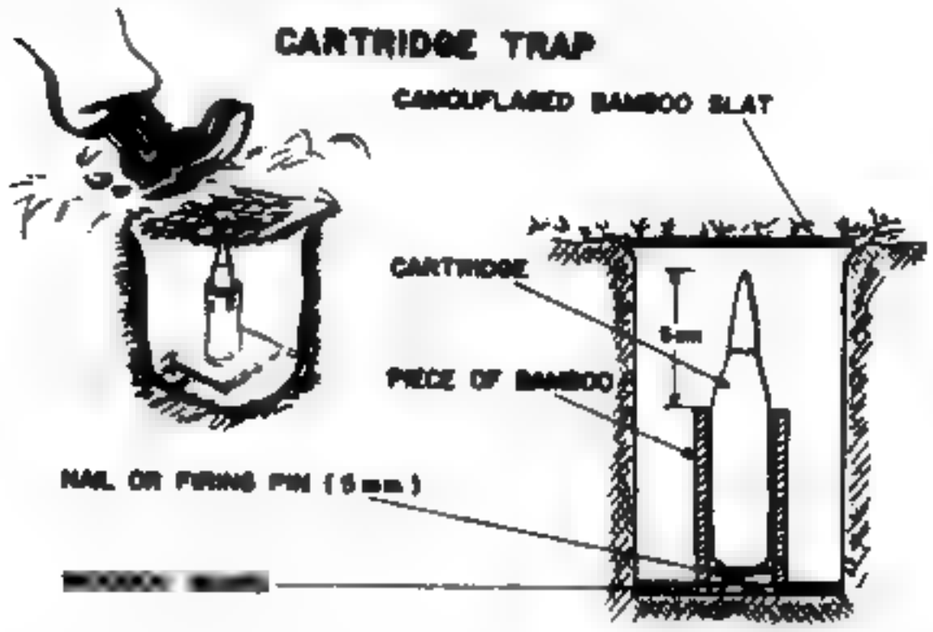
The bounding mine is improvised from expended U.S. M2 bounding mine or M48 trip-flare cases. A wooden cylinder slightly smaller in diameter than the mine case is hollowed out so that a standard grenade can fit inside. The wooden cylinder (with enclosed grenade) is then fitted into the mine case and the grenade's safety pin is extracted. When the mine is detonated, the cylinder and grenade are propelled upward. As the wooden cylinder and grenade separate, the handle flies off the grenade, activating the fuse.

VC "TOE POPPER" MINE

This mine is fabricated of cartridge cases or pieces of pipe of various sizes. It is loaded with a charge of black powder, a primer, and a variety of fragments for missile effect. When the victim steps on the mine, the igniter detonates the black powder charge and propels the fragments upward.

CARTRIDGE TRAP

Four simple and easily obtainable components make up this mine; a bamboo tube, a nail, a piece of wood, and any small arms ammunition or M79 round. The piece of wood is used as a base. The bamboo tube is placed upright on the

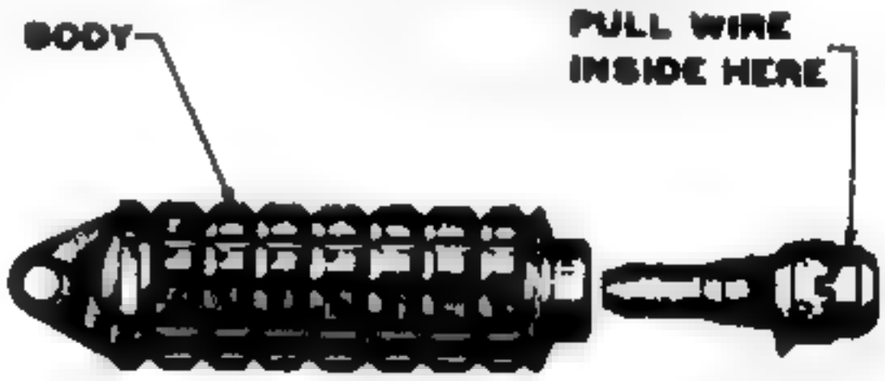


wooden base and a nail is driven up through the wood to penetrate the bottom of the bamboo. The cartridge is then wedged into the bamboo so that the primer is touching the point of the nail. Partially buried along a trail or path, the pressure of a man's foot stepping on the nose of the cartridge forces the primer onto the nail, firing the cartridge.

DIRECTIONAL FRAGMENTATION MINE (DH-10)

Commonly referred to as a "CHICOM or VC claymore," this mine has characteristics similar to the U.S. M18 Claymore Mine. Fused electrically, it is a command-detonating device designed for employment from ambush or defensive positions. It has a range of 150 to 200 meters and is effective against personnel and thin-skinned vehicles.

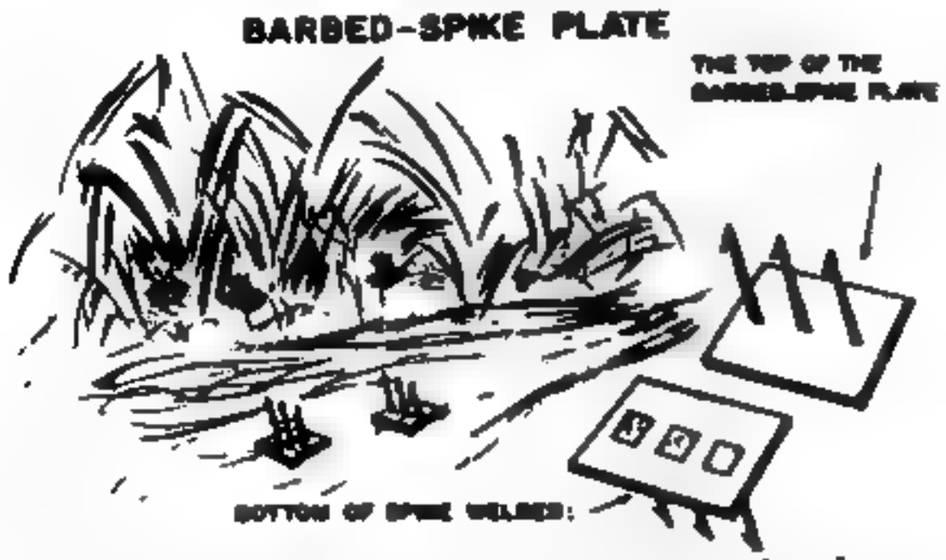
POMZ-2 ANTIPERSONNEL MINE



Chinese Communist copies of the Soviet POMZ-2 mine are now being employed by the VC/NVA. Weighing only 4.4 pounds, it is easily carried and can be emplaced quickly. Fused for detonation by tripwire (tension release or pressure release), it can also be rigged electrically for command detonation.

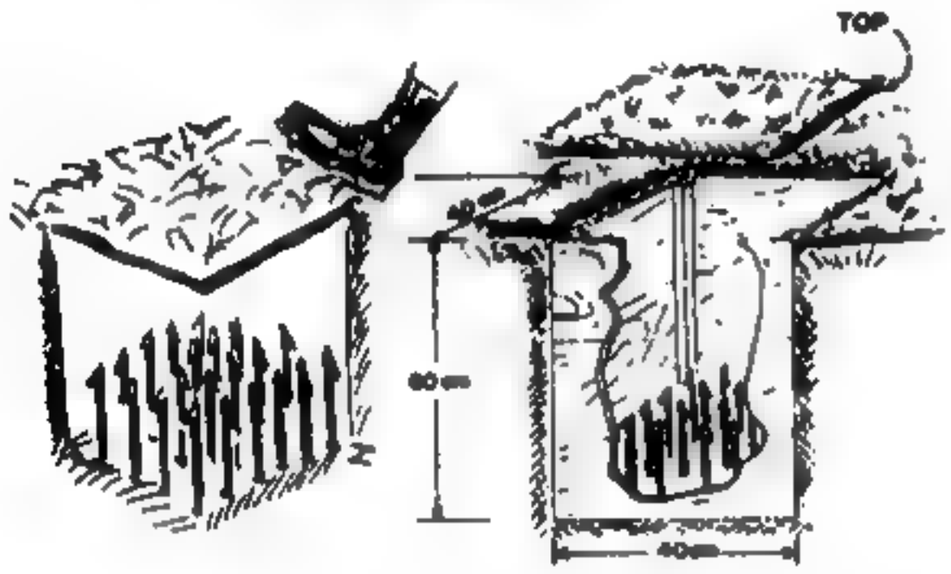
NONEXPLOSIVE BOOBYTRAPS

The idea of nonexplosive boobytraps is as old as man. From the simple earth pit lined with sharpened stakes to highly sophisticated mechanisms of triggered coils and latches, the enemy employs them all. The principle employed is simply to use anything that will catch the victim by surprise.



The barbed-spike plate is the basic element of all enemy nonexplosive booby-traps. The plate, a flat piece of wood or metal, is used as a base to fasten any number of barbed spikes. The spikes, ranging in length from several inches to several feet, are fastened securely to the base. When a man steps or falls on the spiked plate, or is struck by one, the spikes will penetrate, producing a serious wound.

SPIKE TRAP BOX



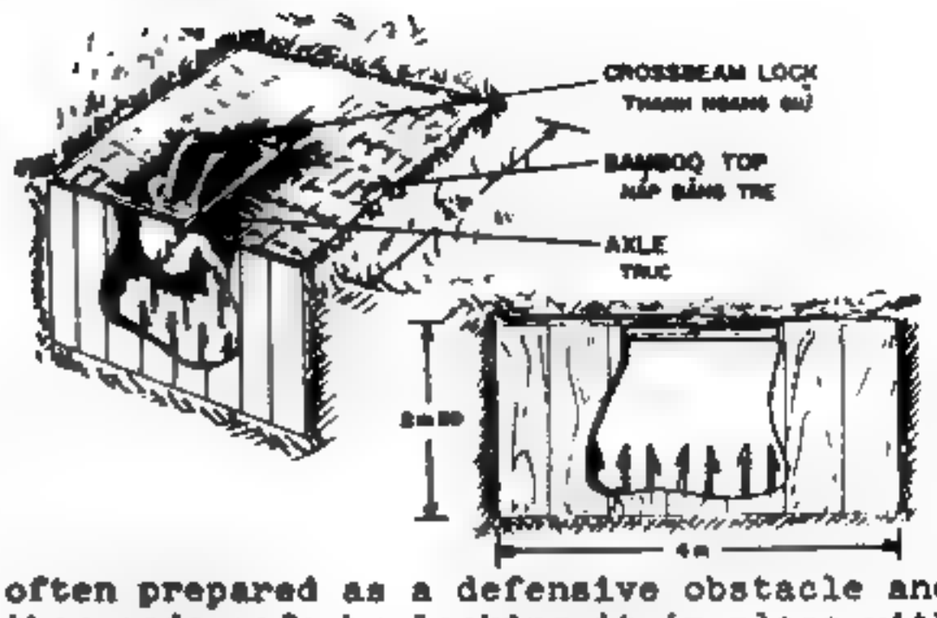
This device is a simple wooden box made of boards joined together with four corner posts. The box has a lightweight top but the bottom is removed. Barbed spikes are placed in the ground at the bottom pointing upward. This trap is usually set up on dirt roads and trails to take advantage of favorable camouflage.

POINTED BAMBOO STAKES

Made of bamboo which has been sharpened, the stakes are stuck in the ground and covered with grass. When a weapon is fired or a grenade thrown, troops seek cover and are impaled.

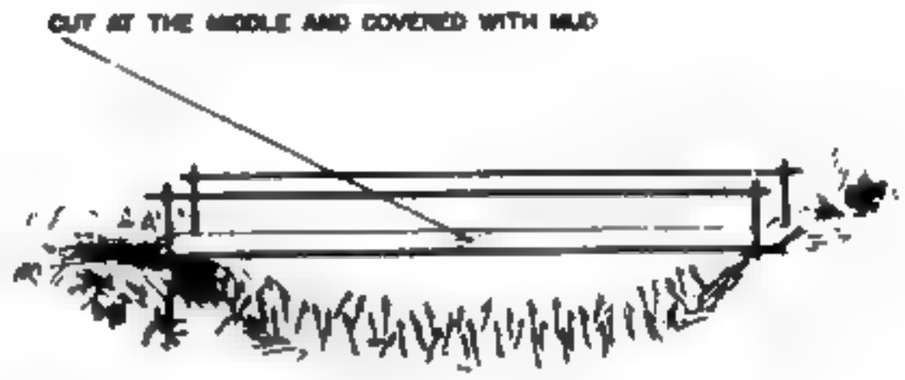
SPIKE TRAP PIT

A trap pit is a large trap box with a bamboo top. Stakes are made of sharpened bamboo or barbed spikes and used to line the box. When a man steps on the trap he will fall into the pit. The top turns on an axle; therefore, the trap does not need to be reset to work again. The pit is



often prepared as a defensive obstacle and then made safe by locking it in place with a crossbeam (so it can be crossed safely by the enemy) until the desired time of use.

TRAP BRIDGE



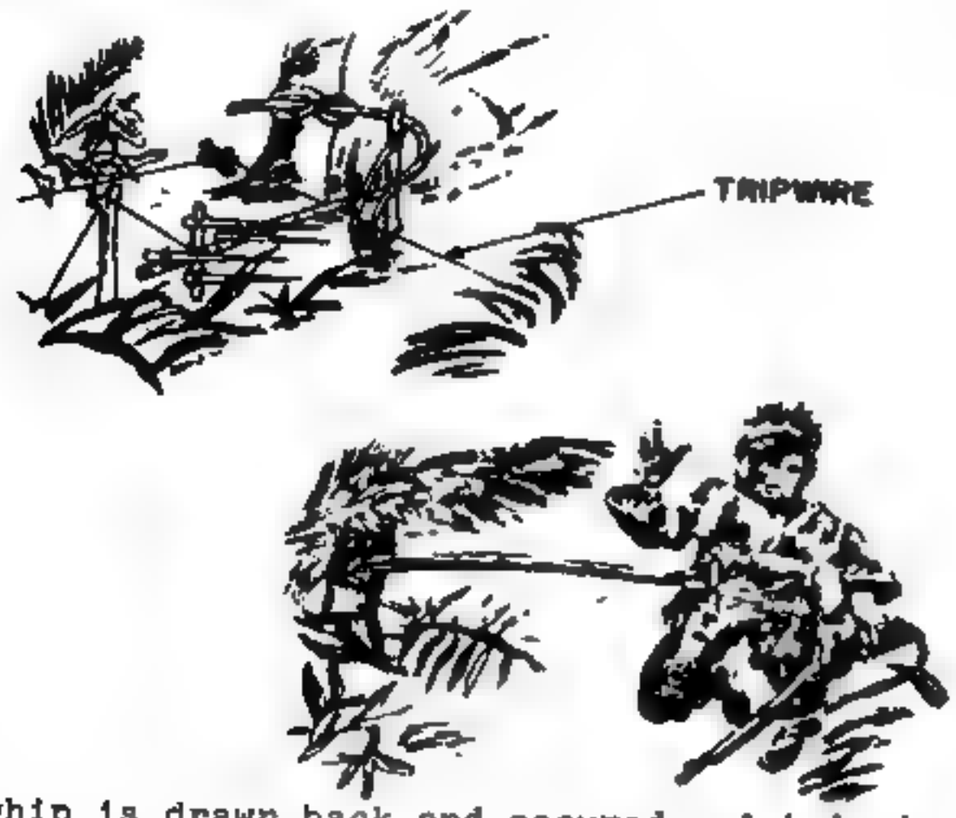
A small footbridge is partially cut in the middle. The cut is then camouflaged with coverings of mud, etc. Barbed spikes or sharpened bamboo stakes are emplaced under the cut, using the water, mud or foilage under the bridge as camouflage. The weight of a man on the bridge will cause it to collapse, tumbling the victim onto the spikes. Like the spike trap pit, bridges can be prepared in this manner, then braced for normal use. At the approach of free world forces the braces are removed.

STEEL ARROW TRAP

This trap utilizes a bamboo tube (usually about 3 feet long) as a launcher. A steel arrow is placed in the tube. Using a block of wood as the bolt, a strip of strong rubber for power and a catch to lock the rubber strip, the device is fired with a tripwire. When the victim trips the wire, the latch disengages, allowing the rubber strip to launch the arrow.

BAMBOO WHIP

A strip of springy bamboo from 3 to 10 feet in length is used to make a bamboo whip. A barbed-spike plate is secured to the tip of the bamboo (or several of the spikes driven through the bamboo), and the

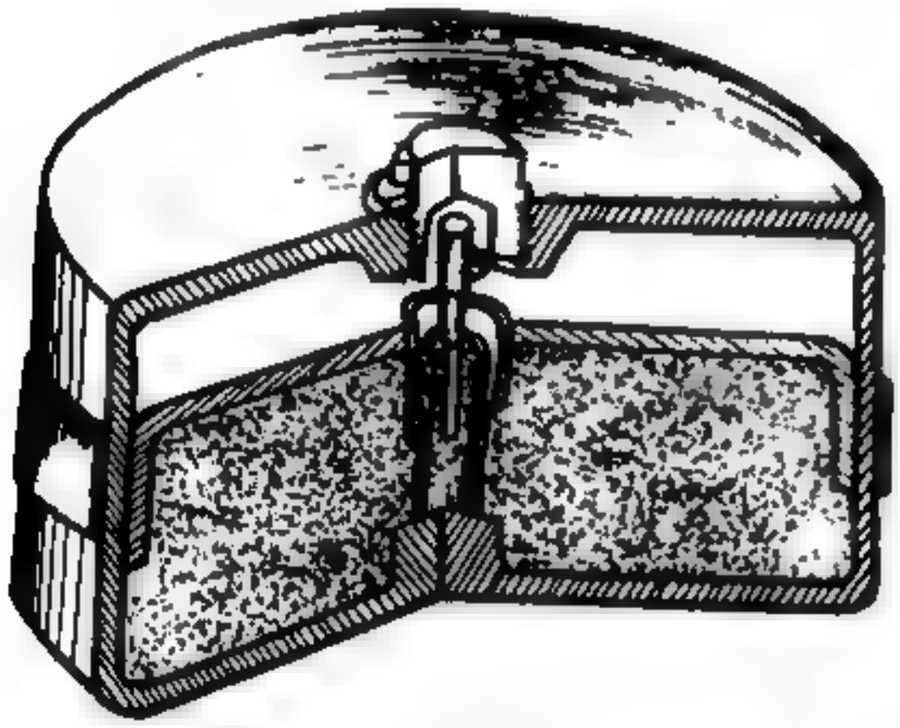


whip is drawn back and secured. A tripwire is then latched to the whip and the wire is strung across the trail. When a man trips the wire, the bamboo is released, and whips around, striking the victim with the spikes.

ANTITANK AND VEHICLE MINES

Mines employed by the enemy against wheeled and tracked vehicles vary from conventional antitank mines of foreign manufacture to rigged duds and locally produced explosive devices. All the industrially produced mines are of the type fused for detonation at from 150 to 400 pounds of pressure. They are buried slightly beneath the surface of the ground. The enemy generally employs these mines as designed but has varied fusing and positioning so that there is no definite pattern.

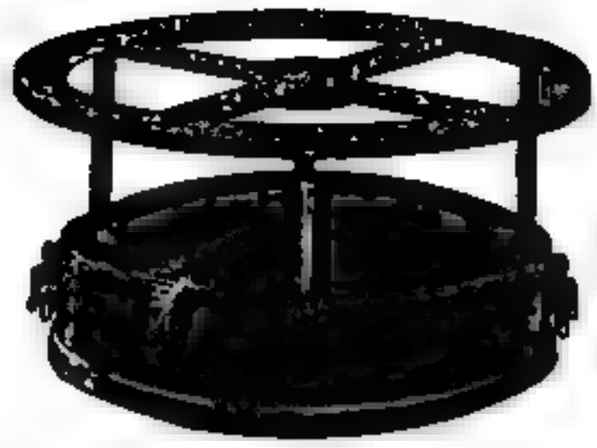
SOVIET ANTITANK MINE TMB-2



Designed to avoid detection by a mine detector, this mine is constructed of black or brown tar-impregnated cardboard, It is gauged for activation by a force of 350 pounds of pressure. Further, it can be waterproofed by use of wood and plastic sheeting, without losing its nondetection characteristic. It contains 11 pounds of explosive and has an overall weight of 15.4 pounds.

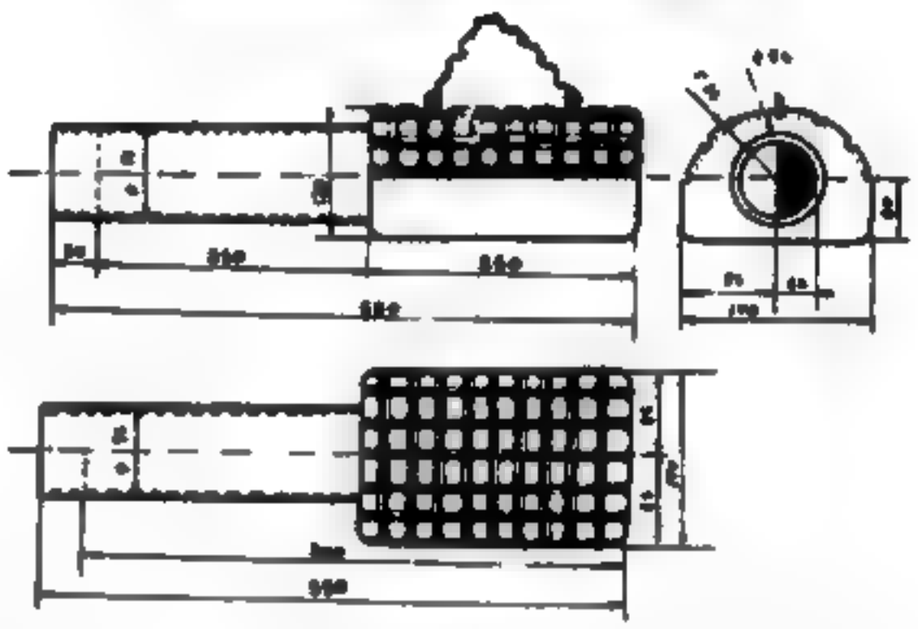
CHINESE COMMUNIST NO. 4 DUAL-PURPOSE MINE

Intended for employment against both vehicles and personnel, this mine incorporates a double-acting fuse that will detonate the mine under either of two circumstances: The first, when a load of



300 pounds of pressure is applied to the pressure spider; the second, when a pull of 10 pounds is exerted on a tripwire fastened to the fuse's striker-retainer pin. Constructed of creosoted metal, it carries 4 pounds of explosive and has an overall weight of about 10 pounds.

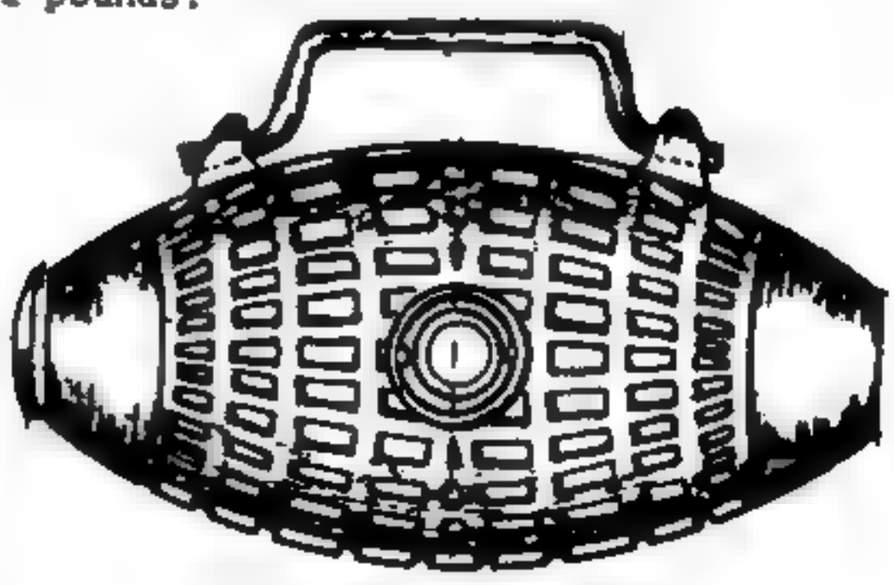
CONCRETE FRAGMENTATION MINE



This mine is constructed of explosive encased in a cylindrically shaped concrete shell with a flat side for stable emplacement. A 2-inch-diameter pipe on one end of the mine serves as a carrying handle and detonator housing. The two swivels on top of the mine are used to tie it to an object. Usually employed as a command-detonating mine, it is equipped with an electrical firing device.

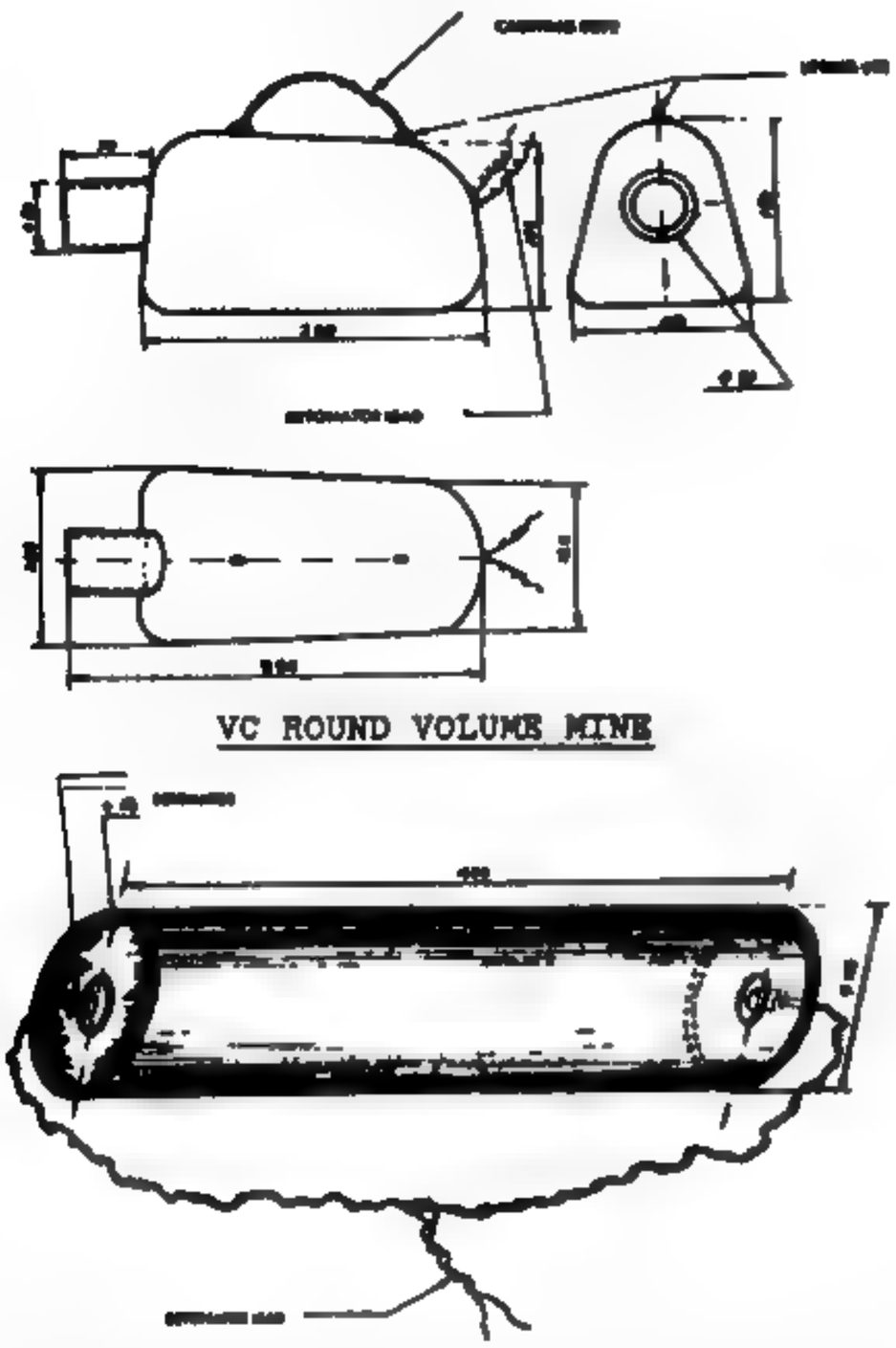
NVA CAST-IRON FRAGMENTATION ANTITANK MINE

Produced in North Vietnam, this egg-shaped mine is made of cast iron with serrations on its outer surface. Designed for command detonation, the mine is fused with an electrical detonator and weighs 12 pounds.



VC MOUND-SHAPED MINE

Manufactured locally in VC mine factories, this mine contains an iron-pipe detonator encased in concrete. Another command-detonating mine, it is fused electrically and weighs 13 pounds.



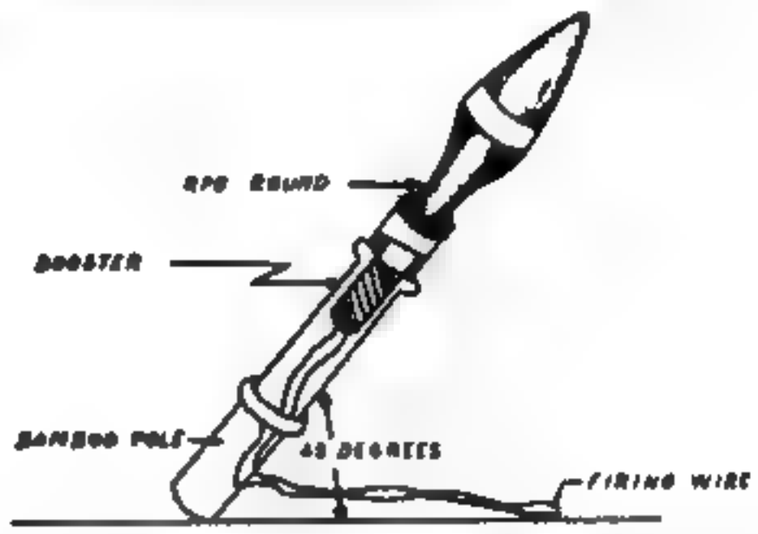
VC ROUND VOLUME MINE

Produced locally in VC mine factories, this mine is a prototype of numerous other VC-manufactured explosive devices. Constructed of sheet metal, with welded seams, it generally weighs about 15 pounds, of which 13 pounds are explosive. Command detonated, it is fused electrically and employs two detonators, one in each end of the mine. The same principle of construction is applied to salvaged artillery shell casings, expended LAAW launchers, and most other devices using metal containers.

VC BOX MINE AND DEMOLITIONS

The VC box mine is constructed of wood utilizing discarded ammunition boxes or any scrap material. Mine detectors will not locate these devices. They can be waterproofed with plastic sheeting. Box mines are produced in various sizes but the most common contains about 40 pounds of explosive. The mine can be fused for command detonation or self-detonation by the use of various devices. The explosive charge is usually made up of standard Soviet or Chinese Communist 1-pound demolition blocks.

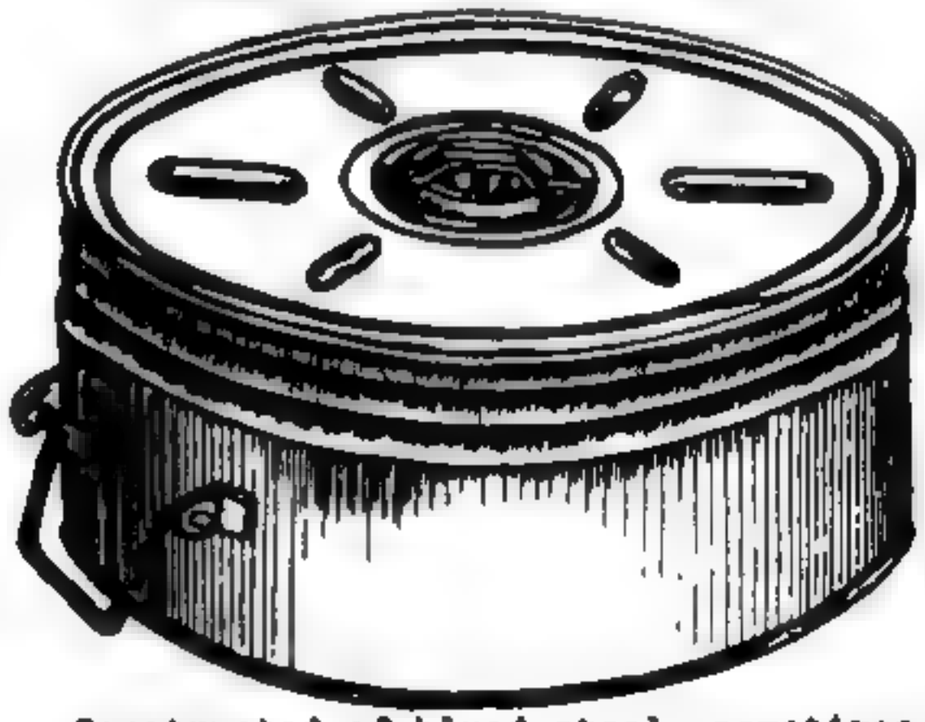
B-40 ANTITANK BOOBYTRAP



ANTITANK BOOBYTRAP

A length of bamboo is emplaced at an angle of 45 degrees along the shoulder of a road. A B-40 rocket is then placed in the bamboo tube and fired electrically by command detonation as the tank or vehicle crosses the line of fire.

SOVIET ANTITANK MINE TM-41



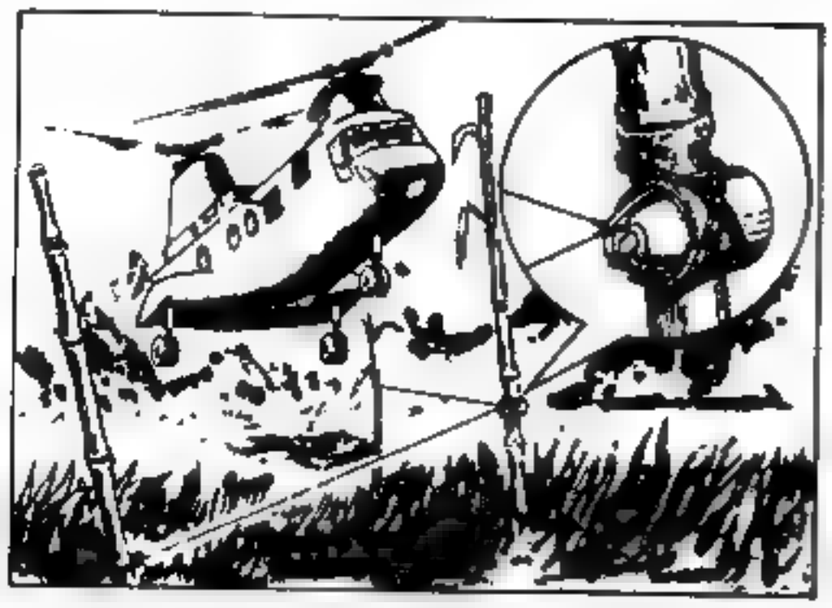
Constructed of blued steel, sometimes painted olive drab or white, the TM-41 carries an explosive charge of 8 pounds and has a total weight of 12 pounds. A force of 350 pounds of pressure on the lid will activate the firing device. With very little additional waterproofing it can remain operational indefinitely.

ANTIHELICOPTER MINING

The degree of success that the employment of helicopters has had on restricting and containing VC/NVA activities is evidenced by the enemy's efforts to destroy or neutralize these machines. In addition to intense ground fire, the enemy has devised numerous helicopter landing zone destruction systems. Such destruction systems range from the primitive planting of long pointed stakes to imaginative explosive devices. Because of its design, the helicopter is extremely vulnerable to these devices, particulary the rotors and airframe.

HELICOPTER EXPLOSIVE TRAPS

Grenades, artillery/mortar rounds, or



any other type of exploding ordnance are mounted in trees or on the surface of the landing zone. The explosive devices are rigged for tripwire detonation and the wire is strung to loosely emplaced poles. The rotorwash of landing helicopters will blow the poles from their loose position, tripping the device.

A 13-year-old Vietnamese boy recently claimed that the VC had forced him to reconnoiter helicopter landing zones. The boy was instructed by the VC to place handgrenades in the zones with strings wrapped around the levers, pieces of paper attached to the free ends of the strings and the rings (pull rings) pulled. Rotorwash from landing helicopters would then blow the paper, unwrap the string, and release the safety lever.

Gunpowder Manufacture

Scientific American — May 11, 1861

The invention of gunpowder is claimed by the Germans for their countryman, Bertholdus Schwartz; but it is well known to have been in use among the Chinese since A.D. 85.

Some of the best qualities are composed as follows:

	NITER.	CHARCOAL.	SULPHUR.
Army powder.....	75	15	10
Sporting.....	78	12	10
Mining.....	65	15	20
French	78	12.88	9.12

The ingredients are first reduced to an impalpable powder in cylinder mills worked by water power, or between metallic rollers. It is next weighed, then properly mixed in a mixing trough with a wooden roller for three hours, and at some mills it is merely stirred about in a large tub for a short time; but when this is the case, more time is allowed for incorporating, which is the next process. The cylinders of most incorporating mills are two in number, and made of a very tough description of stone; they each weigh about three tuns. The bed of the mill on which they revolve is of the same material; but cylinders and beds of iron are also much used. The objection to iron beds is that they generally wear hollow in the middle, and it would be out of the question to have stone cylinders and iron beds. The charge which is placed in the mill at a time is 42 lbs., and it is moistened with 2 pints of water, which is placed in the mill with the charge; but this is varied according to the state of the atmosphere. At the end of three hours, the charge is withdrawn from the mill to be pressed either in a hydraulic or a powerful screw press; it is separated at equal distances by plates of copper so that a uniform pressure may be applied to the whole, which is about 600 tuns. When taken from the press it is in thin solid cakes or layers, called "press cake." This is broken in pieces of about a quarter of an ounce in weight, and removed to the corning house where it is granulated by placing it in sieves having a rotary shaking motion given to them by machinery, with two blocks of lignumvitæ wood which crush the powder between them and the sides of the sieve; two other sieves of different degrees of fineness are placed under the first, which catch the powder and separate it into fine and coarse grain (for artillery and muskets), and the dust, or meal powder, falls into a box placed beneath. The powder is now glazed by being placed in a cask, which revolves on an axle through the center about thirty times in a minute, which takes off all the corners of the grains and gives them a polish.

The last process is drying, which is performed by steam, radiation from hot irons, or solar heat; it is sometimes again sifted before barreling, to clean it and prevent it from caking together. The pressing and glazing processes, although they lessen the effective force of the powder, are absolutely necessary; first, to give the powder density, to prevent its breaking by carriage; second, to prevent its absorbing moisture from the atmosphere, which it is liable to do from the alkali which is in the charcoal; third, to prevent the powder losing its power when kept for any length of time. The quality of the powder produced depends more on the care taken in its manufacture than on the exact proportions of the ingredients.

COUNCIL TO OUR VOLUNTEERS
HOW TO PREPARE FOR THE CAMPAIGN
The Scientific American — May 11, 1861

(The following hints to our volunteers are timely and should be heeded. — Eds.)

TO OUR YOUNG SOLDIERS

1. Remember that in a campaign more men die from sickness than by the bullet.

2. Line your blanket with one thickness of brown drilling. This adds but four ounces in weight and doubles the warmth.

3. Buy a small india rubber blanket (only $1.50) to lay on the ground or to throw over your shoulders when on guard duty during a rain storm. Most of the eastern troops are provided with these. Straw to lie upon is not always to be had.

4. The best military hat in use is the light colored soft felt; the crown being sufficiently high to allow space for air over the brain. You can fasten it up as a continental in fair weather, or turn it down when it is wet or very sunny.

5. Let your beard grow, so as to protect the throat and lungs.

6. Keep your entire person clean; this prevents fevers and bowel complaints in warm climates. Wash your body each day if possible. Avoid strong coffee and oily meat. General Scott said that the too free use of these (together with neglect in keeping the skin clean) cost many a soldier his life in Mexico.

7. A sudden check of perspiration by chilly or night air often causes fever and death. When thus exposed do not forget your blanket.

"An Old Soldier."

Military Pyrotechnics of Former Days

Harper's Magazine — June 1869

SEVERAL French works* have been published in late years under the authority of the French Government on the origin and history of the employment of explosive and deflagrating missiles in war, which throw a great deal of light on the subject, and tend to correct many erroneous ideas which have long been prevalent in relation to it.

The predecessor of gunpowder in the history of war has always been considered to be a wonderful combustible known as *Greek Fire*, of which the most marvelous accounts have been circulating among mankind during the past two or three centuries. This Greek fire has been supposed to be a combustible possessed of most astonishing properties. It was capable of being thrown so as to envelop whole buildings, and even to overwhelm and destroy complete battalions on the field. Water would not extinguish it, but only made it burn the brighter. Nothing would put it out but drenching it with vinegar, or covering it with sand. Its composition, it was supposed, was lost in the fourteenth century, and had never been recovered. The fact that the art was lost was inferred from the fact that no substance possessing the wonderful properties attributed to the Greek fire can be produced at the present day.

It is somewhat difficult at the present day to obtain exact information in respect either to the composition of this substance, the construction of the engines or other apparatus employed in projecting it, or to the effects which it really produced. In respect to the machinery, and the form of the missiles, we must remember that there were no pictorial papers in those days, and no photography to preserve for future generations the exact realities of form and structure connected with the pursuits and usages of men. And in regard to the other points, relating to the properties of the substance, and the actual effects produced, far less reliance can be placed on the statements of even intelligent, cultivated, and careful men than might be supposed at the present day. For the line of demarcation between the natural and the supernatural—between what is and what is not scientifically possible—was then very vague and obscure, even in the highest minds. Ideas of the natural and supernatural were mingled and confused, or rather the supernatural was regarded as a legitimate realm of the natural, so that no tale could be so marvelous as to seem incredible, even to a grave and cautious historian. At the present day the recitals of excited or terrified witnesses, whose imaginations or whose fears lead them entirely to misconceive what they see, are at once corrected by that general knowledge of the relations of cause and effect which now prevails so extensively among all well-informed men that the bounds of the possible can not be very easily transgressed in narrations generally received. But it was not so

Ricin: Its Manufacture and Use

By Kurt Saxon

The beauty of ricin as a poison is that it doesn't act until three or four days after ingestion. In this way, the victim doesn't know he's doomed until days later. In most cases he'd be hard put to remember anything that might have caused his illness. He dies of what seems to be pneumonia.

The dosage can be as little as one 2000th of a grain. A grain is about the size and weight of a grain of rice or wheat. That's how the grain measurement got its name. If you could split a grain into 2000 parts, one of those parts of pure ricin would be fatal to the average man.

It is best administrated under the skin or in the lungs, by breathing in. Even so, taken by mouth it is still highly effective, even in very tiny amounts.

The two articles on ricin at the end of this article tell of survival by accidental ingestion by adults of castor bean dust or of children who live after swallowing a few beans. But when relatively pure ricin is administered on purpose; when the victim breathes it in, gets it under the skin, or swallows it, he is doomed. There is no known antidote.

The treatments indicated are to help the accidential victim fight off the effects of castor beans or their dust. It doesn't work with refined ricin. Nothing does.

The ricin you'll be making may not be completely pure but whereas one thoroughly chewed bean can kill a man, the ricin extracted fro mthat bean should kill several.

To make my ricin I used one ounce, or 60 beans, and got less than 1/16th of an ounce of the albuminous toxin. Even so, used sparingly, that is a lot of ricin.

The books say that ricin is an albumin. Egg white is also an albumin. I reasoned I should take out the 55% of oil from the castor beans as the books say it isn't in the oil. After the oil is removed the albumin containing pulp remains. The next step was to extract the albumin from the pulp and the whole process is childishly simple.

Castor beans are grown as decorative outside plants. They also yield up to 55% oil so can be gotten in bulk from some seed companies. If you live in southern California or other mild climate you can often find them growing wild. The seeds are prominent and can be easily collected in the fall. But unless you are around at the right time it's best just to buy them.

So far, the process is relatively safe. But for handling the powdered, oil-freed pulp, buy a dust mask and pair of rubber gloves from your hardware store or pharmacy. Surgical gloves and mask cost less than $1.00 at the pharmacy.

CASTOR BEAN, JEQUIRITY BEAN

Handbook of Poisons
R.H. Dreisbach — 1955

The castor bean plant (Ricinus communis) is grown for commercial and ornamental purposes. The residue or pomace after castor oil extraction of castor beans gives rise to dust which may cause sensitivity reactions or poisoning.

Jequirity (rosary bean, Abrus precatorius) is grown as an ornamental vine in tropical climates. The beans are 6 mm. (1/4 inch) long, bright orange with one black end. They are used as rosary beads and as decorations for costumes.

Ingestion of only one castor or jequirity bean has caused fatal poisoning when the beans were thoroughly chewed. If the beans are swallowed whole, poisoning is unlikely because the hard seed coat prevents rapid absorption.

in those early times.

In respect to the apparatus by means of which the compound of combustibles known as Greek fire was projected into the enemy's works, some representations have come down to us, though only from comparatively modern times. The use of such means of attacking the vessels or fortresses of the enemy seems to have been resorted to in very early times, since allusions to them occur not unfrequently in the works of writers who lived and wrote several centuries before Christ. Indeed, one of the recipes for making such compositions, as they were employed in those early days, is still extant. It is as follows:

"To make an unquenchable fire take pitch, sulphur, tow, manna, resin, and the scrapings or saw-dust of resinous wood, such as torches are made from. Mix these substances well, then light the mass and throw it against whatever you wish to set on fire."

It is obvious that such a mixture as this would form an exceedingly combustible compound; but it could not possess any of those marvelous qualities which were attributed to the Greek fire. It could not burn under water, though some substances, as will presently be explained, have this property.

The use of combustibles of this character seems to have been first resorted to in the countries lying about the eastern shores of the Mediterranean—unless indeed the Chinese, and some of the other Oriental nations, anticipated the Europeans in this, as they have done in respect to many other important discoveries. The reason why the use of such a mode of warfare appeared first in these Oriental countries is supposed to be because in that region are found natural deposits of certain combustible fluids, such as naphtha, and other vegetable oils, which were admirably adapted to this use. At any rate the employment of such subetances appears first conspicuously in history in the time of the Greek empire. A great many recipes are extant describing the different kinds of composition employed. They all, however, consist of a mixture of simple combustibles, depending for flagration on access to the air.

These subetances were placed in barrels, balls, or other receptacles, and thrown by means of various mechanical contrivances known in those days into the works of the enemy.

The *Slinging Engine*, represented at the head of this paper, was constructed to throw a barrel of the combustible compound by means of a gigantic sling, seen in the engraving as thrown open from the end of the beam, after the projection of the barrel. The beam was drawn back by means of the rope wound round the capstan, shown behind and below it. Its elasticity, after being thus brought into a state of great tension, was then suddenly released, when the end of the beam, carrying the barrel of combustibles, previously set on fire, was thrown violently forward and the barrel hurled from the sling, all in flames, into the works of the enemy.

A battering engine, the design and operation of which is obvious, stands by the side of the sling.

The subjoined engraving, copied from an illumination in a Latin manuscript of the thirteenth century, gives a representation of the mode of employing the Greek fire in naval warfare. The craft here represented seems to be in some sense the prototype of the modern bomb-proof, ram, and fire-ship, all in one. But although this drawing is taken from an ancient work, no absolute reliance can be placed on the details of the construction as represented in it, inasmuch as such drawings were made in

Ricin, a toxic albumin found in castor beans, and abrin, a similar albumin found in jequirity beans, cause agglutination and hemolysis of red cells at extreme dilutions (1:1,000,000). They are also injurious to all other cells.

The pathologic findings in fatal cases of castor bean or jequirity bean poisoning include hemorrhages and edema of the gastrointestinal tract, hemolysis, and degenerative changes in the kidneys.

Clinical Findings:

The principal manifestations of poisoning with these beans are vomiting, diarrhea, and circulatory collapse.

A. Acute Poisoning: (From ingestion.) After a delay of one to three days, nausea, vomiting, diarrhea, abdominal pain, drowsiness, disorientation, cyanosis, stupor, circulatory collapse, and oliguria may begin and progress to death in uremia up to 12 days after poisoning.

B. Chronic Poisoning: (From inhalation of dust from castor bean pomace.) Dermatitis and inflammation of the nose, throat, and eyes. Instances of asthma have also been reported from exposure to the dust.

C. Laboratory Findings:

1. The urine may show albumin, casts, red blood cells, and hemoglobin.
2. The blood may show increase in urea and N.P.N.

Treatment:

A. Acute Poisoning:

1. Emergency measures —

a. Remove ingested beans by gastric lavage or emesis followed by catharsis

b. Maintain circulation by blood transfusions

2. Antidote — None known.

3. General measures — Alkalinize urine by giving 5 to 15 Gm. (75 gr. to 1/2 oz.) of sodium bicarbonate daily to prevent precipitation of hemoglobin or hemoglobin products in the kidneys.

4. Special problems — Treat anuria

B. Chronic Poisoning: Remove from exposure.

Prophylaxis:

Children should not be allowed access to castor beans or jequirity beans.

Dust from handling castor bean pomace should be controlled by proper air exhaust.

Prognosis:

The fatality rate is approximately 5 percent. Death may occur up to 14 days after poisoning.

RICIN

A MANUAL OF PHARMACOLOGY
TORALD SOLLMANN, M.D. — 1924

Occurrence, Clinical Symptoms and Treatment — This toxin is contained in the castor seeds, but does not pass into the oil. Similar phyto-toxins occur in croton seeds (Crotin); and in jequirity seeds (Abrin); in the bark of the locust tree, Robinia pseudacacia (Robin); and in the seeds of some leguminous plants (Phasin). The last is but weakly toxic (Review of Literature, Ford, 1913). The ricin is responsible for the toxic effects on eating the castor seeds; five or six of these are fatal to a child, twenty to adults; three or four seeds may cause violent gastroenteritis, with nausea, headache, persistent vomiting, colic, sometimes bloody diarrhea, thirst, emaciation, and great debility. The symptoms usually do not set in until after several days. More severe intoxications cause small frequent pulse, cold sweat, icterus, and convulsions. Death occurs in six to eight days, from the convulsions or from exhaustion. The fatality is about 6 per cent. This small fatality is due to the destruction of the poison in the alimentary canal. The treatment would be evacuant and symptomatic. Three to ten days are required to complete recovery (Critical Review and Bibliography,

those days for purposes of embellishment, and not for instruction, and so only a general resemblance to the natural object, sufficient to suggest its character and use to the mind of the reader, was all that was usually aimed at. It was, in other words, the *ideal* and not the *actual* presentation which the artist had in mind.

All that can be certainly inferred, then, from such an illustration is, that a species of vessel was made use of in those times covered with a roof sufficient to protect the navigators from spears and arrows, and provided with a pointed prow to act as a ram, and projecting beams bearing barrels charged with materials for producing the Greek fire.

Another form of vessel is given in an ancient manuscript, differing materially from the last. In this the barrel containing the fire is suspended from a species of *crane*, by means of which it could be swung over the decks of an enemy's ship when in close quarters. In this, as well as in the other case, all that we can infer from the drawing is the general nature and design of the contrivance, and of the principle on which it operated. The true proportions of the parts and the details of the construction were purposely disregarded in illustrations of this kind.

Observe in the engraving the extra barrel of combustibles ready upon the deck, and the circular watch-box on the top of the mast, where a look-out-man could be stationed, under protection from the spears and arrows of the enemy, and yet at the same time in a position to observe every thing through the slits in the box, and so to direct the helmsman in guiding the vessel. Weapons of the character of boarding-pikes are placed, ready for use, at the stern.

The damaging and destructive effects of the Greek fire were not confined to its power of setting the enemy's works on fire. It contained substances which emitted fumes of a horribly offensive, poisonous, and destructive character. It was necessary on this account that the wind should be in the right quarter, that is, blowing from the assailants toward the enemy, whenever it was employed. Sometimes the receptacle containing the composition was placed upon the end of a long spar attached to a car, which was to be propelled by hand. The soldiers would pile up a great quantity of wood before the gate of the castle or strong-hold attacked. This car would then be driven by soldiers stationed behind it, where they were protected by an inclined shield from the assaults of the enemy. The shield is perforated with openings, to enable those within and behind it to see where to apply the fire; and it contains a place of shelter within, forming a receptacle which would be useful in various ways—among others, for the protection and succor of wounded men, and for taking them back to a place of safety.

By this arrangement the wood heaped up before the door of the fortress might easily be set on fire, and if the wind was in the right quarter, and if the wood had been previously prepared by being covered with pitch, naphtha, and resins, the consequence would be an immediate bursting forth of volumes of fierce flame and suffocating smoke, which would drive over the wall, penetrate the works, and make it impossible for the men to draw near for the purpose of doing any thing to arrest the mischief.

The ancient manuscripts referred to above contain illustrations of the use of the Greek

Continued on page 34

Ford, 1913).

Effects on Animals — The actions can be best studied on rabbits, by hypodermic or intravenous injections. Even with the latter, there is an incubation period of at least twelve to eighteen hours before symptoms appear. These correspond to those described for man. They are partly local — gastroenteritis; and partly central — paralysis of the respiratory and vasomotor centers. The local inflammation also occurs on other mucous membranes to which the poison may be applied, especially the conjunctiva.

The autopsy findings are very characteristic. They consist in swelling and reddening of Peyer's Patches and mesenteric lymph glands, internal hemorrhages and diffuse nephritis. Cruz, Flexner, Mueller and others have shown that these lesions are not due to thrombosis, but to direct action on the tissues. The site of the injection is boggy.

Frogs have a much higher resistance than mammals. The phytotoxins have no direct effect on muscle or nerve.

Action on Blood — in vitro, ricin hemolyzes and agglutinates the corpuscles of nearly all warm-blooded animals (Stillmark, 1886). The agglutination does not seem to occur in the body, but is of great importance as an immunity phenomenon. Leucocytes, epithelial and other cells (except those with thick membranes, as yeast) are also agglutinated; as likewise the stroma of laked corpuscles (Elfstrand). The presence of serum hinders the effect.

The agglutination has been referred to precipitation of the nucleoalbumins (Stassano) or other proteins, such as those of serum (Kraus, 1902). All kinds of colloid precipitates carry down ricin, and it is absorbed by solid proteins and lipoids.

Nature of Ricin — This appears to be a true protein; for a preparation of ricin has been obtained, which is a typical albumin, and which is so active that 0.0005 mg. is fatal to a kilogram of rabbit; i.e., 1 part of the ricin is fatal to 2,000,000 parts of rabbit; the fatal dose for man would therefore be about 0.035 mg., or 1/2,000 grain (Osborne, Mendel and Harris, 1905; Osborne, 1909). The agglutinating action is also very powerful.

The attempt has been made to separate the agglutinin (which is adsorbed by blood corpuscles) from the cytotoxin, which is destroyed by peptic digestion. Jacoby, 1902, believes that they have certain groups in common.

Antiricin — Injections of the phytotoxins produce typical antitoxins, so that an immunized animal can survive 5,000 ordinary fatal doses of ricin. Some of the basic work of Ehrlich was done with ricin and abrin. He showed (1891) that the immunity starts in five to six days, and lasts six or seven months. The resistance of the corpuscles is unchanged, the antiricin being contained in the pseudoglobulin fraction of the serum (Jacoby, 1902). It contains antitoxin, antiagglutinin (probably identical) and precipitin. Madsac and Walbum found that this combination obeys the same laws as diphtheria antitoxin. The toxicity of ricin is modified rather complexly by lecithin (Lawrow, 1913).

Here is the new process for highly potent castor bean powder. Since one well-chewed castor bean can be fatal, the same bean with the oil removed would take up only half the volume.

Since it's relatively tasteless, the powder can be sprinkled in a sandwich, on a salad, in a bowl of soup, or whatever. For lower varmints, use the powder liberally on baits. In a few days you'll be shed of whatever vermin troubles you.

This doesn't mean ricin bullets or darts should be discounted. Under the skin, the stuff is much more potent. A hollow-point .22 bullet, spread out slightly and packed with finely powdered castor bean would surely be fatal. But use a drop of mucilage instead of water in the powder and let dry a few days and seal with Elmer's Glue.

With the darts, just mix half a bean's volume of powder with enough mucilage to make a moldable mass and mold it on the dart just below the sharp point and let it dry. If you've already made the original ricin darts, I'd go with them.

Back to the new process for making castor bean powder. Really fine and fluffy powder can also be used in even a diabetic hypodermic needle. Mix the powder from one bean in one cc of water, suck it up and it's ready to go. That doesn't mean you process the beans individually. Just measure the equivalent. This is especially good for euthanasia, like in a IV tube or anywhere on a comatose body.

To get the best powder you'll want to remove the hulls. Put two ounces of water in a glass and pour in a teaspoonful of lye (sodium hydroxide) from any grocery store. Wait until it cools and put in one or two ounces of beans. They float so put a weight on them to hold them under. Soak one hour.

Then wash them thoroughly and dry them in a towel. The hulls expand and can easily be cracked along the sides with a fingernail. A few minutes practice will have you shucking right along and it will give you something to do while watching TV and meditating on your sins.

Put the hulled beans in a glass or metal blender with four ounces of acetone to each ounce of beans. Blend them until they are the consistency of milk and put them in a glass jar with a lid for three days.

Then swirl well and pour the brew into a coffee filter in a glass, opaque plastic or metal funnel. When the dripping stops, take out the filter and gently squeeze out the remainder of the acetone. Spread the filter on a newspaper and let it dry.

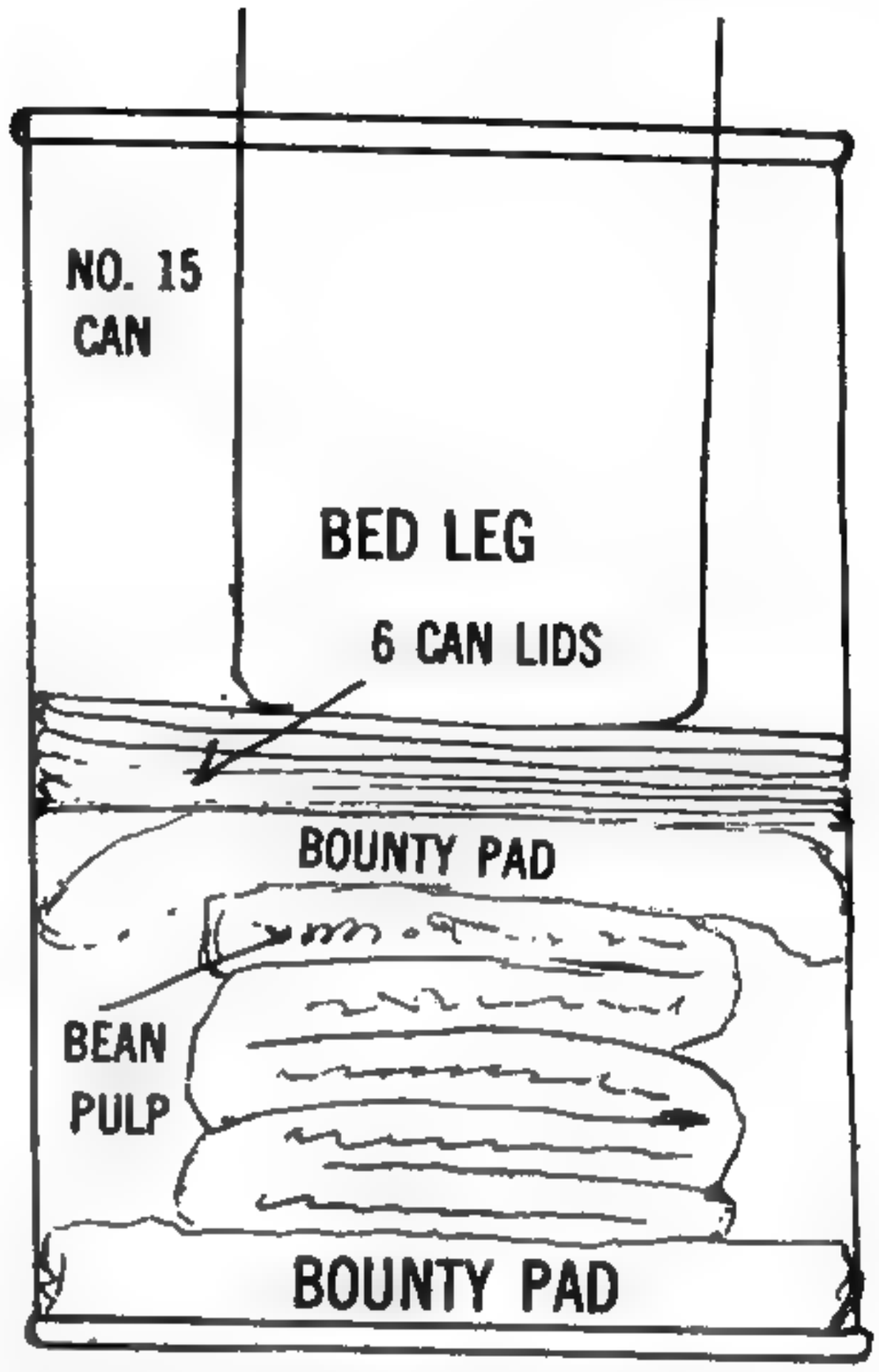
Although most of the oil is out of the pulverized beans, some of it may be picked up again as the acetone-oil mixture goes through the pulp while it's in the filter. If, after the acetone has evaporated from the powder, it still holds together after being compressed, it still has too much oil in it. Put it back in the jar and pour in four more ounces of acetone. Swirl well and let it set another day.

Repeat the process and you should have pure, oilless powder. Don't let this get up your nose or the noses of anyone you don't want out of the way.

Castor Bean Oil Press and Final Ricin Progress

By KURT SAXON

If you really like to improvise, just use a No. 15 can from your kitchen and maybe a half dozen lids from other No. 15 cans. The material to be pressed is put in the bottom of the can, the extra lids are put in on top and a bed leg is lifted and then lowered into the can, exerting 60 or more pounds of pressure and more while the bed is being slept in.



Pressing oil is simple. First you dissolve one teaspoonful of lye in a cup of water and put the seeds in. Put a weight on them to keep them submerged. Soak for one hour. Dry them and remove the hulls with your fingernails. You might use a pliars to squeeze the seeds from opposite ends until they crack open. This makes it easier to pick off the hulls.

When hulled, spread the seeds between sheets of paper and mash them all with a hammer. When they are thoroughly mashed, scrape them off the paper and spread them thinly in an inch wide strip down one side of a sheet of Bounty paper towel.

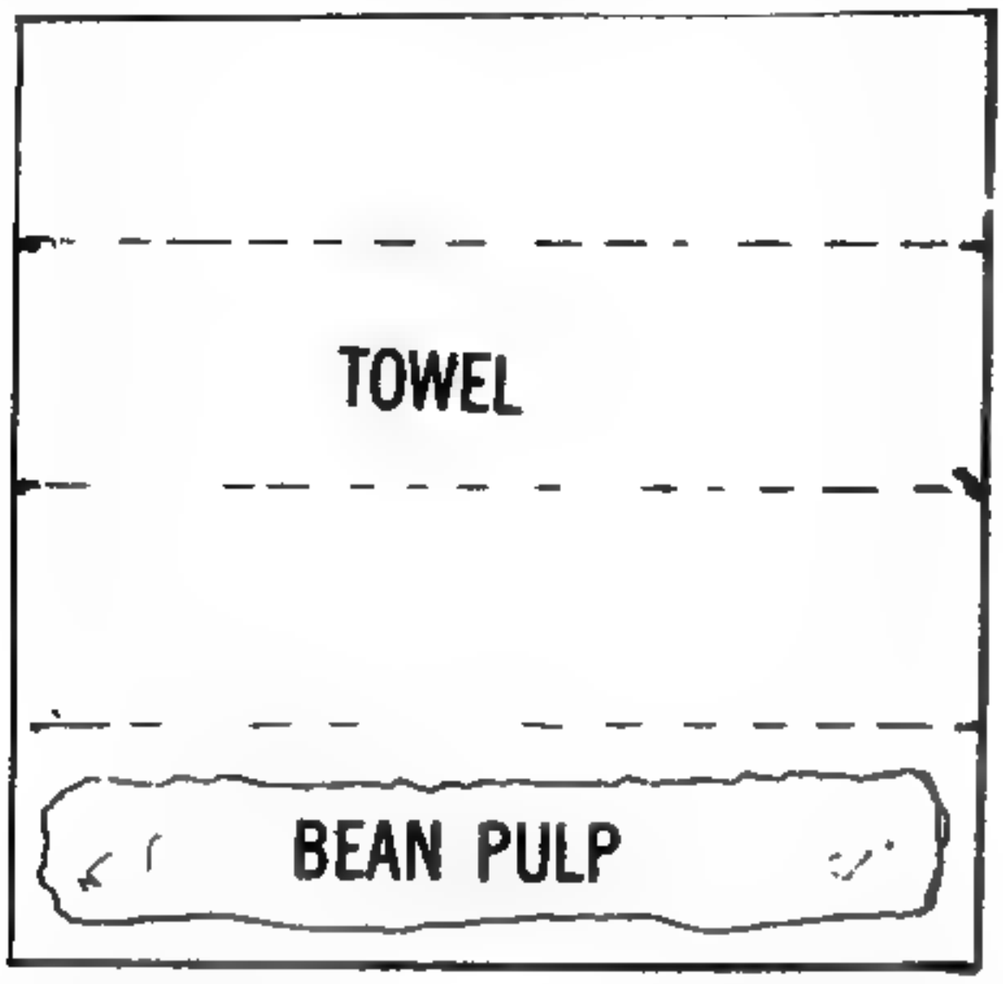
The pulp spread section is then folded over three times so there is two thicknesses of towel on each side of the pulp.

A paper towel is put in the bottom of the can. The four-folded towel is put on the toweling at the bottom. Then another section of towel is wadded or folded to fit the can over the pulp enclosed towel. Next, six or more lids are forced in over the toweling and the bed leg is put in. The number of lids keeps them rigid so the pressure is uniform.

This method doesn't really take any time. Just go about your business while the pressing is going on.

When you feel most of the oil has been removed, pulverize the pulp and put it in a jar. Next, mix 3/4 of an ounce of table salt with seven ounces of water. Pour it in with the pulp, put on the lid and shake the jar vigorously. Shake it as often as you like but leave it in the saline solution for about 48 hours to let the albumin dissolve. Then strain it through a coffee filter.

When strained, you might squeeze the filter full of pulp to remove some more of the liquid. Then dispose of the



pulp.

Next, mix one teaspoosful of Epsom salts in three ounces of water. Pour this in the container holding the liquid left after straining the pulp. Stir and after a few minutes you'll see white flakes precipitating out of the liquid and falling to the bottom. These flakes are the ricin. After a half hour or so, pour the liquid into another coffee filter. When the liquid has drained away, what you'll have in the filter is some pretty pure ricin.

Dry it in an unventillated cabinet and gently scrape the ricin from the filter paper. Once it's dry, during the scraping process and from then on, wear a dust filter mask (bought at any pharmacy) as a fleck or two up your nose should be enough to kill you.

Ricin Bullets

A while back, NBC Magazine showed the 357 Magnum Teflon coated bullets which would go through three folds of Kevlar body armor. Such bullets cost about $35.00 per box of 50.

Much was made of the idea that their only practical application would be for assassination. I agree. Few criminals wear Kevlar vests. Some police and most politicians wear them.

Since most cop killings are close up and spur-of-the-moment, such bullets would seldom be used. But they would be bought mainly by terrorists or criminals whose activities would raise their risks of confrontation. No professional assassin would use a pistol anyway against a target surrounded by bodyguards. He'd use a rifle and go for a head shot. And a deranged person wouldn't be so selective in weapons, buying the cheapest gun or using whatever he already had, usually.

Nor would such bullets be useful against foreign invaders or local marauders. Kevlar body armor is too expensive to be supplied to communist regular infantry and if marauders had the foresight to buy such armor, why wouldn't they stock up on food so they wouldn't have to maraud in the first place?

My main objection to reliance on such a bullet is that even though it will penetrate Kevlar and a 357 Magnum makes a pretty nasty wound, one can still survive if no vital spots are hit. If you know enough of anatomy and are a good shot, why not go for the head?

No matter. My ricin bullets make debates on the Teflon bullet academic. Whereas one can survive a hit from a 357 Magnum, even a minor flesh wound would be fatal if a ricin bullet were used.

The average concealed weapon, especially among women, is the .22. The .22 Stinger is a fantastic little bullet which splinters and really tears the flesh.

I hate to hear people put down such bullets over the general fantasy that the attacker might be a big, beefy, doped-up, enraged brute who can't be stopped with anything less than a .45. You must realize first of all that a criminal wants something for nothing. Whether he wants your wallet or wants to humiliate a woman by rape, the profit or thrill is gone if he's hurt. So if he's shot, his first consideration is to not get shot again, regardless of the caliber.

And if he happens to be the psychotic fiend he might turn out to be, any resistance, or even lack of it, might get you killed. If you mean to resist, resist with deadly force. If you're going to die anyway, you'll have the satisfaction of knowing you're taking him with you. In the event that he's a "non-violent" mugger or rapist and flees after one shot, and a flesh wound at that, you still might as well rid the world of him.

Incidentally, it's a Federal offence to own or use poisoned bullets. But who's to know? Unless you tell someone, I can see no way anyone, much less the Feds, could find out.

Say you're attacked, for whatever reason, by a degenerated street punk. He knows his territory. He's not going to jump you when there are cops or a significant number of witnesses around. He has no police protection; no concerned witnesses on yours or his behalf. He belongs to you!

One .22 Stinger, or any make, in the kneecap (easy even for the untrained) or the hip or upper leg will let him know he's hurt and will usually down him. If he's just a mugger or rapist he'll know his cause is lost and he'll just want to get away. In the meantime, you just walk away and never even consider reporting your action.

Regardless of what you do to him, he still doesn't want to be jailed for what he tried to do to you. If wounded, he doesn't want to go to a hospital where he would be questioned. Even so, he'd probably say another punk shot him, rather than any victim of his.

Such persons often know a back-alley, unlicensed doctor to crawl to when hurt while in the commission of a felony. So when he dies a few days later of ricin poisoning, he'll just be another derelict found dead in a dirty tenement sleeping room.

Even if he did die in a hospital days later of "pneumonia", it wouldn't be likely that they'd suspect ricin. His illness would probably be listed as a complication caused by his lowered resistance to disease. If he died in the hospital, even after identifying you, you'd have a much better chance of the thing blowing over than if he lived to sue you for defending yourself.

Your basic consideration in carrying a concealed weapon, ricin bullets or no, is that there is virtually no

way of being detected as long as you are minding your own business and don't tell anyone. If you are threatened, don't let fear of reprisals by society outweigh any present danger. It's always best to be judged by twelve than carried by six.

To arm your hollow-point bullets with ricin, just put a drop of water on a small pile of ricin and make it into a paste. Then smear it into the hollows until they are full and set them aside for a few days to dry. Then put a drop of Elmer's glue over the hollow to seal it.

The opening in Stingers and other hollow-points can be enlarged by using a ball point pen. Before putting on the glue take a pair of small pliars and, using a bit of rubber or leather to avoid damage, crimp the hollow back to its original sized opening.

Ricin Update

By KURT SAXON

My original ricin was quite effective, being extremely potent even in the form of hulless, de-oiled castor bean powder. However, it wasn't really professional, since it couldn't be called pure.

Several readers sent in methods to get a purer product. But John Minnery's contribution of the government formula, which is for manufacturing ricin as a military weapon, is the ultimate.

It calls for castor beans to be ground, heated and pressed.

United States Patent Office

Patented Oct. 23, 1962

3,060,165

PREPARATION OF TOXIC RICIN

Harry L. Craig, Cincinnati, and Otto H. Alderks, Wyoming, Ohio, and Alsoph H. Corwin and Sally H. Dicke, Baltimore, and Charlotte L. Karel, Silver Spring, Md., assignors to the United States of America as represented by the Secretary of the Army

Filed July 3, 1952, Ser. No. 297,142
2 Claims. (Cl. 260—123.5)

This invention relates to the method of preparing toxic ricin

Ricin is a protoplasmic poison prepared from castor beans after the extraction of castor oil therefrom. It is most effective as a poison when injected intravenously or inhaled, the latter requiring extreme comminution and small particle size to be effective. It is believed that the toxic action is catalytic rather than stoichiometric which probably accounts for the high toxicity of the agent.

Because of its relative instability, ricin must be handled with extreme care. In neutral aqueous solution it is stable only up to 60°-75° C., and in solid form up to 100°-110° C., although for short exposures, temperatures up to 130° may be tolerated. It is sensitive to acids, alkalis and halogen and may also be inactivated by mechanical working such as grinding or pulverizing. These factors are of great importance in developing a satisfactory method for preparing the material

Although ricin has been prepared in crystalline condition in the laboratory in small quantities, it becomes necessary, for purposes of toxicological warfare, to prepare relatively large quantities in a high state of purity. This necessitates that as much as possible of the non-toxic material present be removed in the process.

In preparing the protein material, the castor beans are first ground and pressed to remove most of the oil. The pressed cake still retains about 15% oil and this may be removed by means of solvents which will extract an additional 150 pounds of oil per ton of beans and reduce the oil retained in the cake to a little over 1%. In the event that the expressing step is supplemented by solvent extraction, it is important to prevent detoxification of the protein during the solvent removal step. If residual solvent is removed from the ground beans by blowing with steam, considerable detoxification results. Blowing with nitrogen effectively prevents detoxification but is expensive when carried out on a large scale.

After the oil has been removed, the pressed cake or pomace is extracted by agitating with water at a pH of 3.8±0.1 at 25° C. which removes substantially all of the toxic protein. The extraction process is operative within a pH range of about 3 to 4.5 although the preferred range is about 3.5 to 4. The optimum operating point is a pH of 3.8± .1, as indicated above. A careful pH control is essential in order that as much non-toxic protein as possible may be eliminated and also that the filtration rate may be held at a satisfactory value. Either HCl or H_2SO_4 may be used to get the desired pH for the extraction water, but H_2SO_4 is preferred due to its lower corrosion rate and ease of handling in concentrated form. The acid should be used in reasonably dilute form to prevent undue local concentrations during its addition. A 5% concentration is satisfactory.

Following the extraction, the slurry is filtered using either a conventional recessed plate filter or a continuous string discharge vacuum filter. With the latter about 7% of filter aid based on meal weight, was found necessary for satisfactory filtration

The filtrate from the water extraction step, which contains the ricin, was treated with a 16.7% solution of Na_2SO_4 to precipitate the protein. This solution is com-

posed of 20 pounds of salt in 100 pounds of water and the amount used was such that the salt content equalled 20% of the filtrate weight. This amount and concentration of salt solution was about optimum considering the factors of cost and toxin recovery. Somewhat higher concentrations and larger amounts of solution can be used, however.

The precipitation process is not limited to the use of Na_2SO_4, since a saturated solution of NaCl can be used successfully, but Na_2SO_4 solution gives better nitrogen fractionation, more rapid precipitation, and can be operated under wider pH limits. It is desirable to raise the pH to about 7–8 before precipitation as this gives better recovery and greater non-toxic nitrogen removal. The pH was raised to this value by using NaOH or Na_2CO_3, the latter being preferred. The base used was quite dilute in order to prevent detoxification due to high local concentrations in the solution. A 5% solution of NaOH was used, whereas with Na_2CO_3 a 12% solution was preferred. In general, this higher pH during precipitation gave a greater non-toxic nitrogen fractionation and at the same time maintained the toxin loss at less than 2%.

After precipitation, the slurry was filtered using from 1 to 4% filter aid, based on slurry weight for satisfactory filtration; the amount of filter aid needed being dependent on the type of press used. Washing the filter cake with Na_2SO_4 solution removed additional non-toxic nitrogen which is desirable. In this washing step a 16.7% solution of Na_2SO_4 was again used. This washing step removed an additional 15% of non toxic nitrogen from the cake.

After filtration the filter cake, which contains the ricin in combination with the Na_2SO_4, may be dried and slurried with CCl_4 to separate the ricin by flotation. Separation of the ricin after a single precipitation and washing step is possible, but it is preferred to carry the process through an additional extraction and precipitation step. This is accomplished by slurrying the filter cake in three times its weight of water and the pH of the slurry is again brought to 3.8±.1 by means of 5% H_2SO_4. The slurry is filtered and a second precipitation is brought about by adding Na_2SO_4 solution. Although pH control here is no wholly essential it is advantageous to bring the pH to approximate neutrality by adding 12% Na_2CO_3. A precipitation time of 45 minutes was necessary to obtain complete removal of the toxin. In filtering out the precipitate, no filter aid was used and the filter cake was washed with Na_2SO_4 solution on the filter whereby an additional amount of non-toxic nitrogen was removed from the cake. This washing was effective only the first time and repeated washings had little effect in removing further non-toxic nitrogen.

The ricin-Na_2SO_4 precipitate was dried at about 50° to 60° C. on a hot air tray dryer. The dried product was ground to pass a 40 mesh screen and agitated with 5 times

its weight of CCl_4, which served the separate the ricin from the Na_2SO_4 by flotation. After settling the ricin was skimmed off the top. This reduced the Na_2SO_4 content of the mixture from a previous 40 to 50% down to 15 to 18%. About 1 to 2% of nitrogen remained in the Na_2SO_4 salt which could then be used for subsequent precipitations.

The final precipitation produced a particle size of 1–2 mu. On drying the wet cake, however, the ricin cemented together forming larger particles. These could not be broken down to their original size by ordinary grinding methods and since a very fine particle size was necessary in order that the product might be used as a toxic weapon, it was thought desirable to seek some method to prevent the agglomeration or cementing process that took place on drying.

To attempt to affect this result, physical conditions prevailing under the precipitation process were changed. This included changing the temperature of precipitation and the rate of agitation. Other changes included precipitation with only partial saturation of Na_2SO_4 and the use of wetting and seeding agents. None of these expedients produced any significant improvement in particle size.

Ordinary dry ball and hammer milling of the dried ricin produced considerable detoxification perhaps due to the generation of excess heat. The use of CCl_4 slurry plus the use of low temperature and low moisture content of the ricin reduced detoxification during ball milling.

Spray drying proved to be an even better method of securing a reasonably small particle size. Best results were achieved by using a solution having about 20% solids, an inlet temperature of 150° C. and an atomizing air pressure of 150 to 180 p.s.i. The particle size secured was 6 to 8 mu.

The best means of securing a small particle size was by air grinding. This was carried out in an apparatus having a chamber with conical top and bottom. The material to be ground has been fed into this chamber and is withdrawn from the bottom and forced back into the center of the chamber tangentially through a venturi. Compressed air of about 100 p.s.i. was fed to the venturi to provide the grinding force. The fines are drawn off the top and the large particles settle to the bottom to be recirculated and reground. This process produced particles having a mass median diameter of 2.5 to 3.5 mu.

4

Numerous variations are possible in the several steps of the process commencing with the water extraction and precipitation which may be a single or multiple step. Although a single extraction step can be used, as indicated before, some process modifications are necessary for its successful operation on a plant scale. Double extraction proved to be quite efficient but additional steps beyond the second extraction step were not found necessary.

The drawing is self-descriptive and shows the various steps of the process described.

We claim:

1. In a method of preparing toxic ricin from castor beans comprising slurrying an expressed castor bean cake with water to remove the water soluble ricin and precipitating the ricin from the filtrate, the further steps which include slurrying the precipitate with CCl_4 and separating the ricin by flotation.

2. A process in accordance with claim 1 in which the precipitate is dried prior to slurrying.

References Cited in the file of this patent

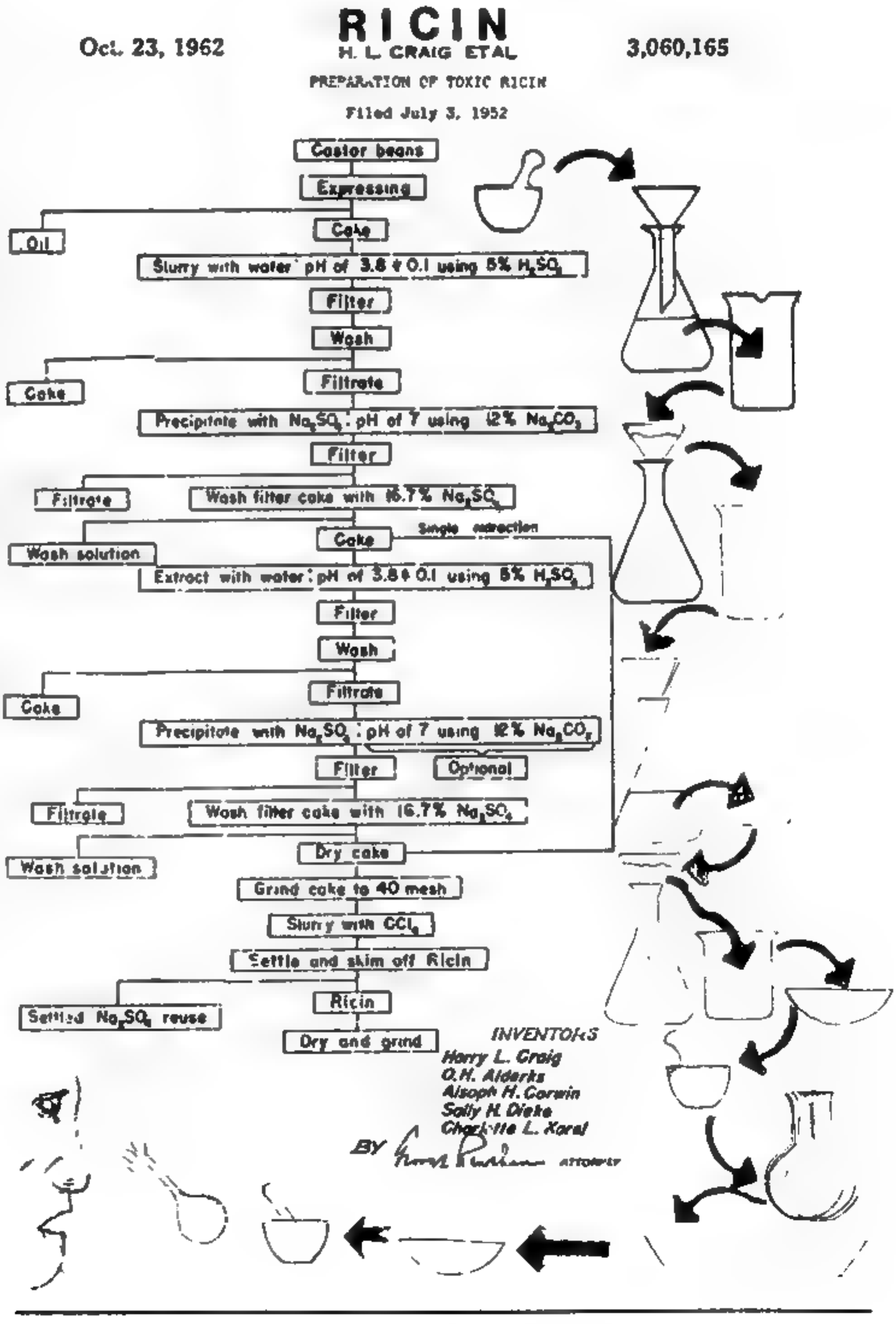
Kabat et al. J. Biol. Chem., vol. 168, 1947, pages 629–39.

Kunitz et al.: J. Gen. Physiol., vol. 32 (1948), pages 25–31.

POTASSIUM PERMANGANATE—GLYCERIN IGNITER

Description: This igniter consists of a small pile of potassium permanganate crystals that are ignited by the chemical action of glycerin on the crystals. It is used to ignite incendiaries and readily flammable material such as rags, dry paper, dry hay, or the combustible vapor area above liquid fuels. Ignition is accomplished by causing a few drops of glycerin to contact the potassium permanganate crystals.

Comments: This material was tested. It is effective but is not reliable below 50° F.



Help!

I've gotten several letters telling me the potassium chlorate process doesn't work for some. I don't know if it's because they can't follow my instructions or if I wrote it wrong.

I updated 4184 — of GRANDDAD'S WONDERFUL BOOK OF CHEMISTRY and put what I thought was an easily understandable diagram on page 6 of THE POOR MAN'S JAMES BOND. It's one of the few I didn't actually test. Rather than do it myself I'll let you figure it out.

If you can't tell me how to do it right, I'll get around to the foolproof process before THE WEAPONEER is completed.

In the meantime, here is the 1872 version and mine. See if you can find any error in my process.

POTASSIUM CHLORATE MAKER (MINE)

When the pan of lye is set up, put two inches of bleach in the bottle and a teaspoon of Sani-Flush and put in the stopper quickly. You won't be harmed by the little gas that will escape during the process but it is unpleasant to smell.

When the bottle stops generating gas, test the lye solution with a piece of red litmus paper. If the paper turns blue it means the stuff is not done yet. Pour the bleach out and give the bottle another dose. When the red litmus paper stays red, that means the lye has been neutralized and the process is finished.

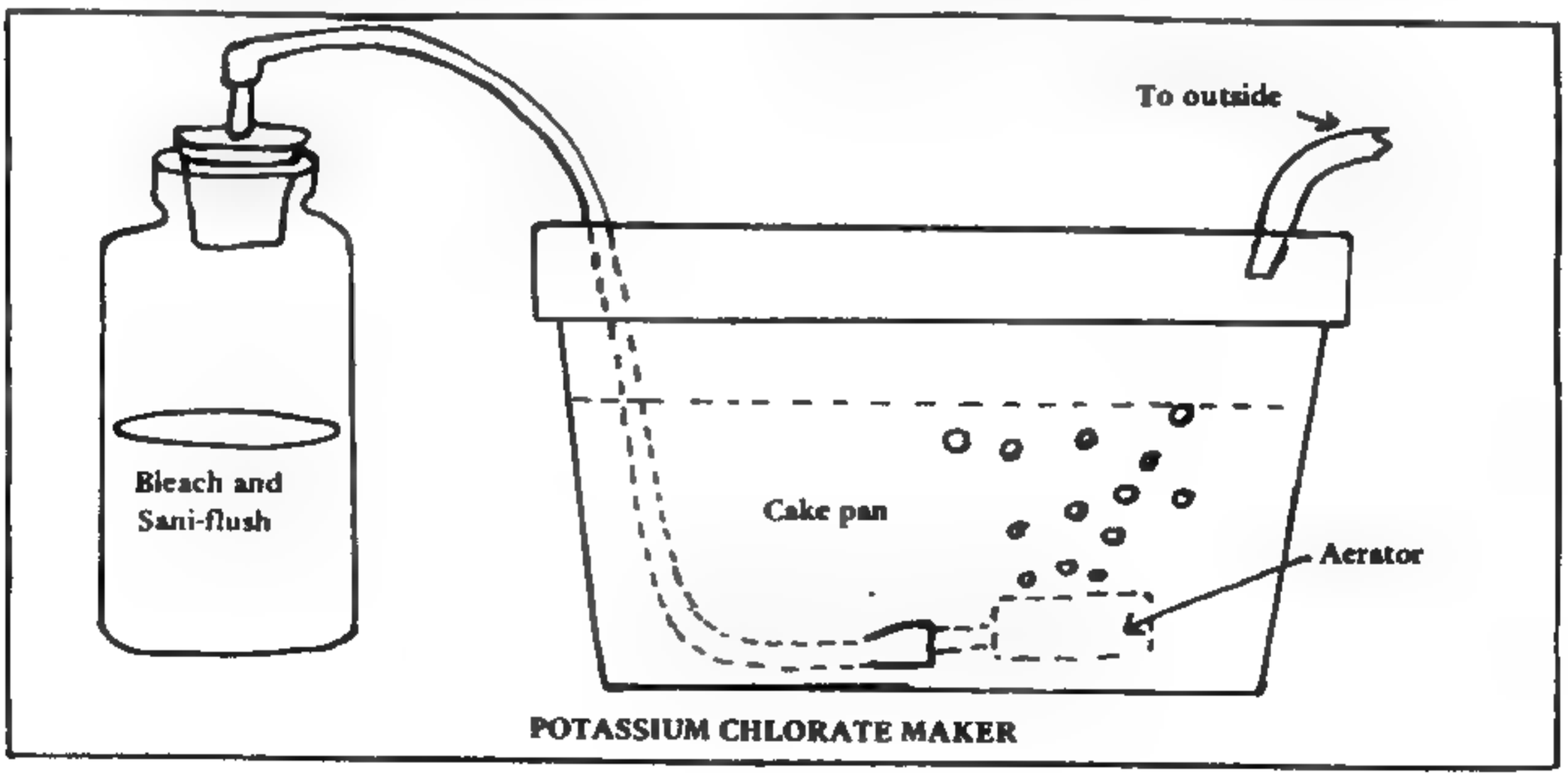
Red and blue litmus paper, for testing acids and alkalies, can be bought at the drug store. If you want the best you should ask for pHydrion paper. This is superior to litmus paper.

When the lye has been neutralized the pan is put on the stove and brought to a slow boil. Then turn down the fire until there is no turbulence on the surface. Let it evaporate this way until a thin layer of crystal forms on the surface. Then turn off the fire and let it cool.

As it cools, four and six-sided, pearly scales will form. After several hours, when all crystallization has stopped, collect the crystals and dissolve them in their own volume of cold water. Put the solution in a smaller pan and repeat the crystalizing process. This time you will have purepotassium chlorate and any impurities will remain in solution.

Granddad's Wonderful Book of Chemistry 1872 Process

Chlorate of Potassa. Transmit chlorine gas through a moderately strong and warm solution of pure caustic potassa, or its carbonate, until the alkali be completely neutralized, then boil for a few minutes, gently evaporate until a pellicle forms on the surface, and set it aside, where it will cool very slowly. Crystals of the chlorate will form as the liquor cools, and must be collected, carefully washed with a little ice-cold water, and purified by resolution and crystallization; the product is pure chlorate of potassa. The mother liquor, which contains much chloride potassium, by evaporation will yield more crystals, less pure than the former, or it may be saved for a future operation. This salt crystallizes in four and six-sided pearly scales; dissolves in 16 parts of water at 60°, and in 2½ parts at 212°. At about 450° it undergoes the igneous fusion, and on increasing the heat almost to redness, effervescence ensues, and fully 39 percent of pure oxygen gas is given off and the residue becomes changed into chloride of potassium. When mixed with inflammable substances, and triturated, heated, or subjected to a smart blow, it explodes with great violence. It also fulminates when thrown into strong acids.



POTASSIUM CHLORATE MAKER

Potasium Chlorate

Dear Mr. Saxon:

I checked the potassium chlorate process and it is correct. The only thing wrong with it is that you've shown the aerator which conducts chlorine gas into the solution near the bottom of the pan. This is unwise because of the increased hydrostatic pressure which could prevent the chlorine from bubbling through the solution. To remedy this, put the chlorine delivery tube just beneath the surface of the solution. I have checked out the chlorine generating system with bleach and sodium bisulfate. It does work, but the pressure is rather weak so for some people it may not bubble through the solution properly. A more intense pressure can be obtained by using hydrochloric acid and bleach. I have used this system successfully in the past when I was doing a synthesis of chlorobenzene. (There have been some complaints about the Chloral Hydrate Process in the PMJB. Ed.)

As for your problem with the sysnthesis of chloral hydrate, I don't know what's wrong with that, if anything. As far as I can tell the synthesis should work as long as you can get the chlorine to bubble through the alcohol (see my comments above about hydrostatic pressure and the remedy).

One more word about potassium chlorate: If for some reason you can't get the chlorine to bubble through and can't afford a compressor to do the trick, there is a simple way to make it without using chlorine directly. Take 5 lbs. of calcium hypochlorite (bought at a swimming pool supplies company under the name HTH), add enough water to dissolve it completely and then boil the resulting solution for about half an hour. Then add 6.1 lbs. of potassium sulfate (bought at a nursery or garden supply store) to the solution. Calcium sulfate will immediately precipitate and after filtering the hot solution to remove it, the solution can then be boiled until potassium chlorate begins to crystalize out. The beaker is then set aside to cool and after the precipitation stops the potassium chlorate is collected by filtration.

One final note. If you use gum rubber tubing, it will be eaten away by the chlorine gas and you will also risk contaminating the solution with chlorinated hydrrocarbons. Use neoprene or other resistant tubing to correct this minor problem.

J.S.

THE BLOWGUN

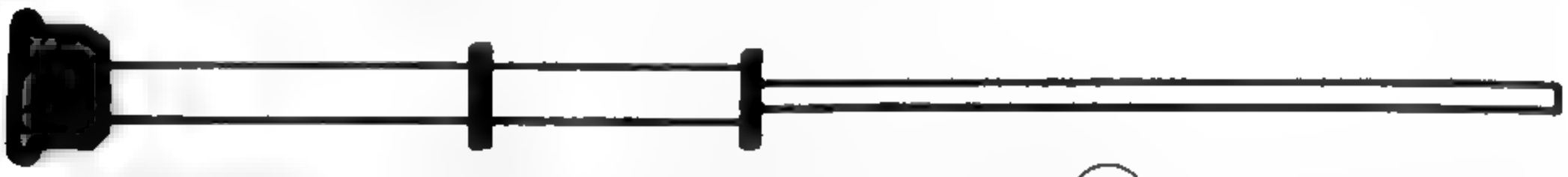
Last week I was at the Tulsa gun show and bought a 4½ foot camouflaged blowgun. It came with several yards of steel wire and 100 plastic beads. I found it amazingly easy to aim and use.

It is indeed a deadly weapon. It has an effective range of 60 feet and will still stick at 200 feet once you learn to give it your best blast of air. It is also light and silent. I want you to order one as I'll discuss it further in the next issue. I guarantee you'll consider it one of the best weapons in your arsenal.

It costs only $16.50 for the camouflaged ($2.00 less for the plain) and comes with enough darts to keep you fascinated for hours. At the end of a few hours you'll be able to hit a six inch circle at 60 feet every time. An enemy across the street would be a dead piegon in a few minutes or a few days, depending on whether you used the potassium cyanide-mucilage coating or the detachable ricin coated barb described on page 38.

A blowgun can be used for hunting any small game — birds, rabbits, squirrels, even fishing. It has been used effectively on 35-lb. raccoons, in Texas on armadillo, and in Kansas on a 10-lb. fish. A head shot or vital organ shot will bring down your game.

The shooting range depends on the length of the gun and the amount of air you put behind the dart. Just a **quick puff** of air sends the dart on it's way — **WARNING, DO NOT INHALE THE DART.** The 4½' gun has a range up to 200'. As the length of the gun increases, so does it's effective range. With practice you can develop velocity of 300' per second.



A FINISHED DART WILL LOOK LIKE THIS . . .

At 20' to 25' a 3-inch dart can penetrate two pieces of quarter-inch plywood. At the same distance a 6-inch dart can penetrate three pieces of quarter-inch plywood.

Darts are made of wire, cut to the length you desire, and a hard plastic bead on one end. Recommended lengths — small game — 3 to 7 inches, fishing — 7 to 10 inches.

The price of each gun includes the gun, sturdy carrying case, enough material to make 100 three-inch darts, and an instruction sheet.

**NOTE: Check local fish and game laws before taking game animals.

Killer Darts

By Kurt Saxon

The simplest, cheapest, quietest and most efficient missile is a poisoned dart propelled from a blowgun. It is also safest for the blowgunner, as the enemy could not be sure where the missile came from or even what it was, in time to react.

With a little practice, the average person with good lungs can put darts in a target the size of an orange from 30 to 60 feet every time. This skill will enable you to pick off a prowler outside or down an intruder in your home. For fun practice you can sit in the passenger's seat of a parked car downtown and zap pimps, prostitutes, fags, politicians and other social derelicts. Just be sure to aim at exposed flesh; face, neck, legs. The darts will penetrate skin-tight clothing but not jackets or loose pants.

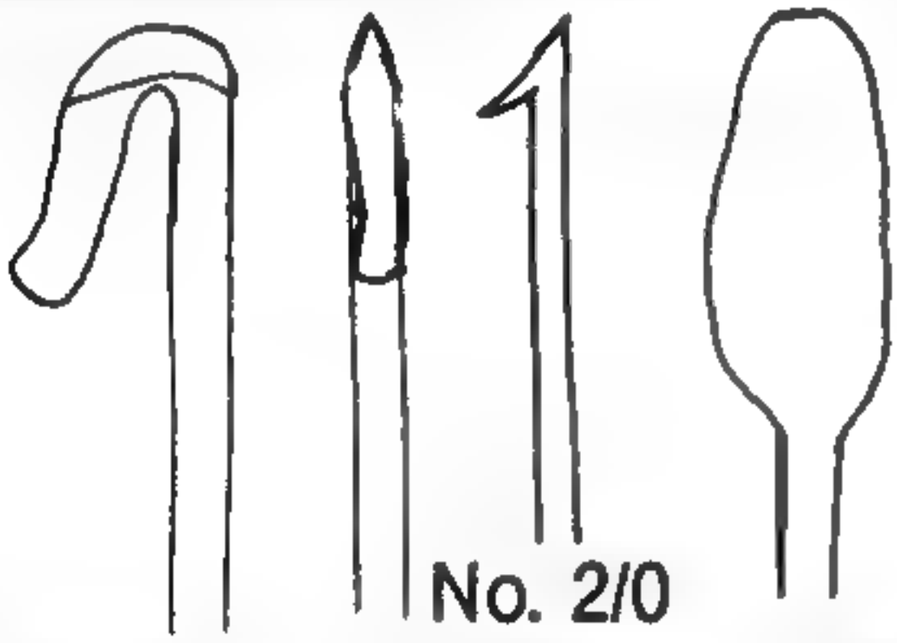
The regular wire-plastic bead dart from three to seven inches are best for practice but can be pulled out of the flesh easily. This makes them inadequate as lethal missiles.

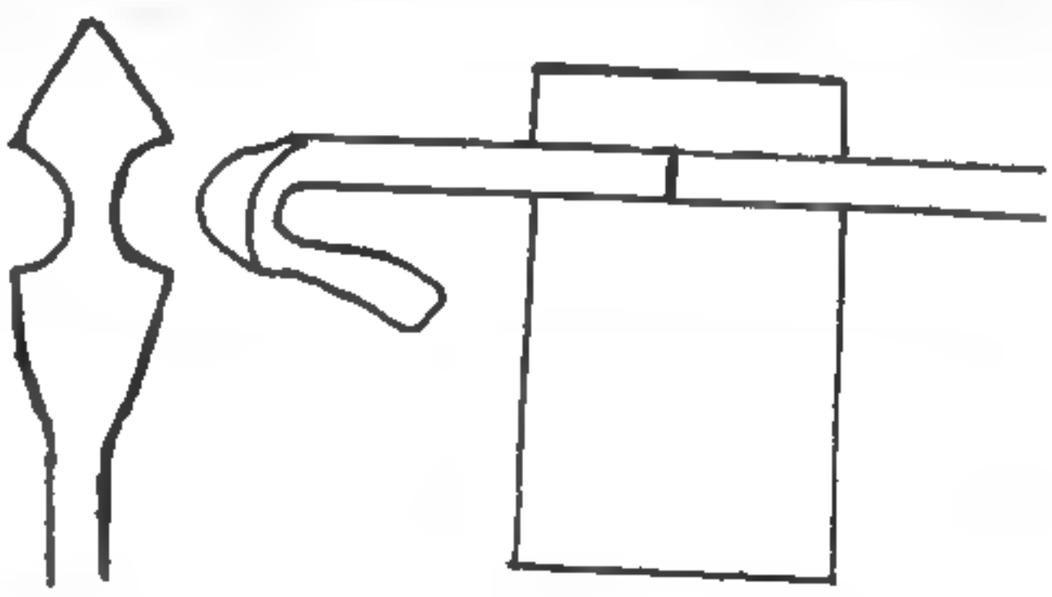
By bending the wire back on itself about a quarter of an inch and sharpening it on a grinder, you will make it difficult to remove. If you want it impossible to remove with the fingers, cut the head off an inch from the tip and roll a half-inch of Scotch tape around both pieces. If the victim pulls the dart, the head will disengage and stay in the flesh. Even if some is projecting, it would take a pair of pliars to remove it.

Fish hook barbs are best but the bronze colored ones break. Try to get No. 2/0 silvery hooks. Bend straight and cut to suit.

The basic wire dart is best for ricin. To coat its head with ricin, mix just a drop of water with a little pile of ricin powder and roll the dart head in it. Wipe off any from the sharpened tip and let it dry.

Ricin tips are for an enemy you want to knock off without a stir. He'll probably think he's just the butt of a nasty practical joke. Unless he called attention to his plight, bystanders wouldn't react.





The quick-killing dart is made from coathanger wire which is heavier and provides the greater surface area to hold the cyanide.

To make darts from coathangers, snip six and a half inch lengths from the straight areas. You will get four darts from each hanger. Heat the ends and put on the plastic beads in the same way you put them on the wire darts.

Then use an anvil or some other block of steel and hammer the tip flat about three quarters of an inch back from the tip. Next, using a grinder or a file, notch the tip on both sides and make a point. The notches will make the tip hold firmly in the flesh.

Cut the head off just a little over an inch from the point. Grind or file smooth both ends of the dart where it was cut so the ends will fit flush with each other when you roll the Scotch tape around the tip and the shaft.

Coating the point with potassium cyanide is the tricky part. Cyanide has to be bound with a substance which will keep it hard and make it penetrate the flesh. I find the best substance to be lePages or Ross mucilage bought at any store in the school supplies section. The rubber applicator should have its slit cut wider so the mucilage can be squeezed out a drop at a time.

The books say a lethal dose is from three to five grains. Get five grains of rice to compare your small piles of cyanide with. To make the cyanide easier to work with, mash it to a fine powder with the bottom of a spoon. It's best to dry off a section by the bathroom or kitchen sink to work with the cyanide. This will give you a hard surface to mash the cyanide and washing up is easy.

After powdering, scrape into piles and put one drop of mucilage on each pile. Take a dart tip and mash the glue thoroughly into the cyanide piles. Then pick up the mixture on the dart head and with the thumb and finger, mold the mass around the flat surfaces. Be sure to wash your hands when you've finished. If you're going to make more than three or four you ought to wear rubber gloves.

The mass tends to sag so it must be laid flat to keep its shape. Also, since cyanide attracts moisture, it will never dry by itself. It must be baked in an oven at between 200 and 250 degrees F. for about 15 minutes.

However, baking it creates a gas, so unless confined, it will bubble and spread into a shapeless, hard, mess. To properly confine it during baking, cut strips of aluminum foil one inch by three. Spray one side with

Cook Ease or any other non-stick spray and let it dry.

Roll the aluminum foil around a pencil with the Cook Ease inside. Then stick the dart tip in and carefully press the aluminum tube around the shape of the dart tip and the cyanide. As it bakes, the gas will escape through the ends and the cyanide will stay confined and form into a rock-hard mass. A little practice will give you uniformly coated dart heads. Be sure to file any cyanide off the sharpened point of the dart.

Since the cyanide attracts moisture, the finished dart heads, Scotch taped to the shafts, should be stored in plastic baggies with all the air pressed out before sealing. This will keep them dry.

When ready to use, they should be carried in the shirt pocket with their tips resting in a plastic bottle with the top cut off and used as a quiver. This way, the tips won't rub against one another, breaking the cyanide or loosening the Scotch tape connections. Out of their plastic coverings, they will last several hours before attracting enough moisture to soften them.

To test how long it would take to dissolve the cyanide, I held it under blood warm water from the faucet. In 15 seconds it was gone. When a missile penetrates the flesh the flesh tightens on it as Nature's way of decreasing loss of blood. Also, great amounts of blood flows to the wound area to carry away any foreign matter. So the dart head in the flesh should be free of cyanide in 15 seconds and in 30 to 60 seconds the enemy should be as dead as a door nail.

If the urban guerillas in Afganistan should use cyanide darts from blowguns, no Russian would be safe. The quickness of reloading could get any two or three dead before they could locate the source. This silent weapon of the night could rid Kabul of Russian vermin.

After some practice, you should be able to load, aim and hit your target with up to 20 darts per minute. This perfect night weapon is an excellent defense against marauders and would make foreign occupation of your territory impossible.

Potassium Chlorate Grenades and Bombs

There's nothing like a case of reliable, devastating grenades to throw at marauders. I favor the potato masher type over the pineapple model. They throw farther, at least for me.

Black powder as a filler is pretty good and pistol powder is great but expensive. Potassium chlorate is fantastic and has great shattering power. It really sends the shrapnel out at an awful speed. It is also relatively easy to get.

Potassium chlorate is unpredictable with fuses. It will go off spontaneously when mixed dry with certain chemicals such as red phosphorous, sulphur, black antimony sulphide, etc. But for controlled situations, most prefer to set it off with blasting caps, since it also detonates by concussion.

It you have access to blasting caps, you can also get dynamite. Dynamite lends itself well to potato masher grenades. So if you can get dynamite, you're all set. Just put a stick of dynamite in a pipe, push in a blasting cap with a length of safety fuse and you're all set.

But if you don't have blasting caps or dynamite you can make do quite well with potassium chlorate. You just need something guaranteed to set it off.

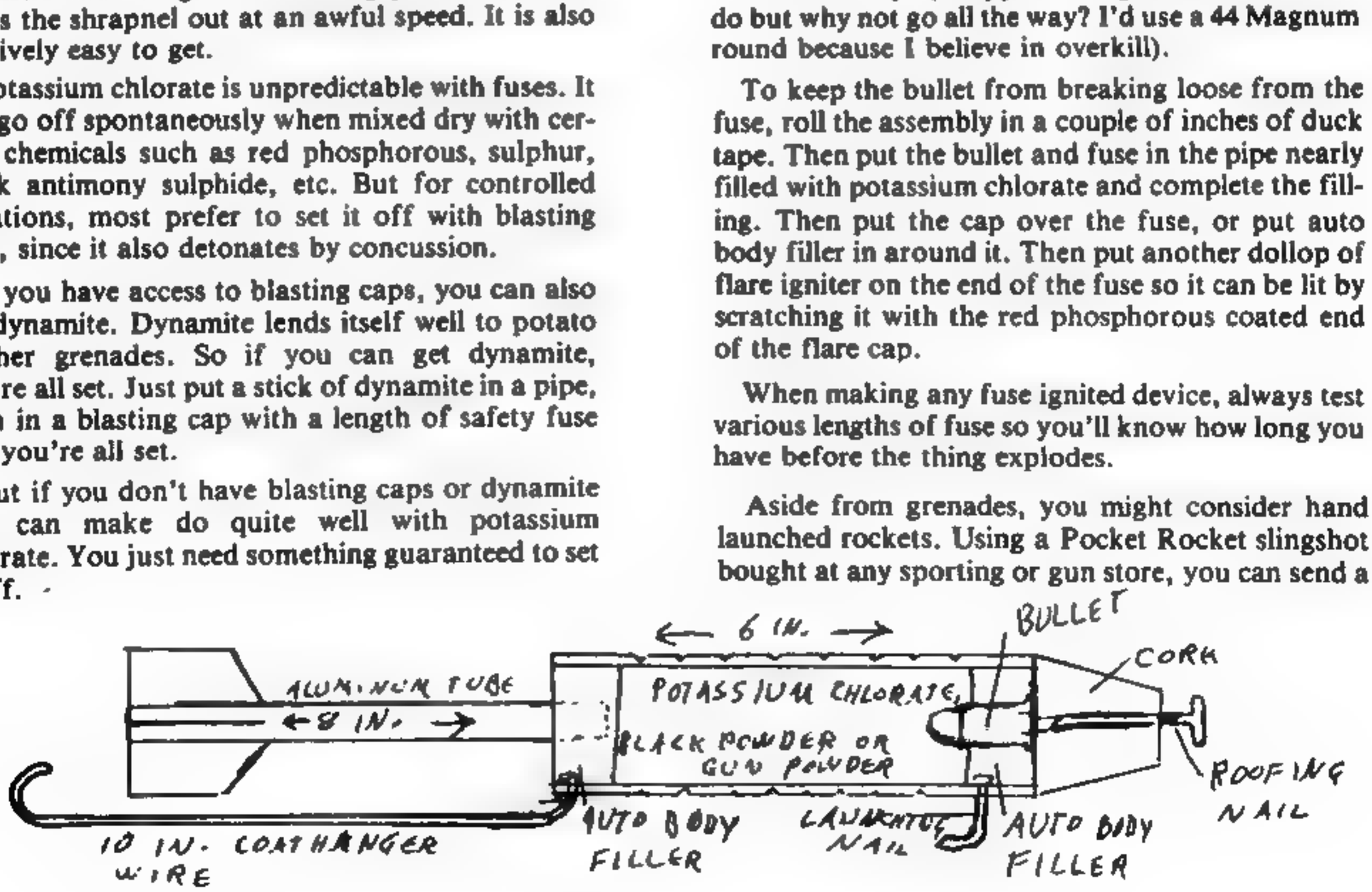
To set off the bullet you'll need some highway flare igniter. (See IGNITERS, page 7 and 8 for fuses and the flare igniter). Since carbon tetrachloride is now almost universally banned, you'll probably have to break up the flare igniter and soak it in its own volume of water overnight.

All you do is put a dollop of flare igniter mush on the end of a 22 LR Stinger cartridge, stick a fuse to it and let it dry. (I suppose a regular 22 LR would do but why not go all the way? I'd use a 44 Magnum round because I believe in overkill).

To keep the bullet from breaking loose from the fuse, roll the assembly in a couple of inches of duck tape. Then put the bullet and fuse in the pipe nearly filled with potassium chlorate and complete the filling. Then put the cap over the fuse, or put auto body filler in around it. Then put another dollop of flare igniter on the end of the fuse so it can be lit by scratching it with the red phosphorous coated end of the flare cap.

When making any fuse ignited device, always test various lengths of fuse so you'll know how long you have before the thing explodes.

Aside from grenades, you might consider hand launched rockets. Using a Pocket Rocket slingshot bought at any sporting or gun store, you can send a



rocket on the order of the incendiary on page 31 of the PMJB a couple of hundred feet with deadly accuracy.

(Although the Pocket Rocket is far more powerful than a regular slingshot, it has one drawback. The nibs which connect the leather strap which holds the PR to the wrist are not fixed. In use, the nibs tend to work off and the PR can fly back and clobber you in the mouth. Work the nibs off, fill them with epoxy and put them back. That way the PR will never come apart).

The pipe of the explosive rocket would be iron plumbing pipe rather than aluminum. Instead of lighting the fuse, you'd want it to go off on impact. For this, turn to page 15 of the PMJB. Use a bullet, but one with a primer instead of a rimfire 22. When you have all the potassium chlorate in, put in the bullet and surround it with auto body filler.

HAND LAUNCHED ROCKET

If you'd like to jazz up your rockets with fins, you can shoot them up and rain rockets amidst groups of marauders. With a few of these, after some practice with dummy rockets of the same weight, you can eliminate any number of marauders too far away to throw at.

From page 25

fire by foot-soldiers in armor, or by men on horseback or in chariots of war. The torch borne by the foot-soldier, or by the horseman, was used often for the purpose of setting fire to the wooden works of the enemy, or to heaps of combustibles previously piled up before a gate or other point assailed. There are accounts, also, of large bodies of men being thus armed to operate against a hostile force in array upon the open field. But this method of warfare could not be employed with advantage except when there was a strong wind blowing from the position of the assailants toward that of the assailed. In this case the advancing line would be preceded by a cloud of smoke, consisting of the most poisonous and suffocating vapors, before which no human being could stand.

The lances used in these cases were formed with an iron receptacle for the fire at the end. This receptacle terminated in points at the extremity, which formed a very efficient weapon after the fire was exhausted, or even perhaps while it continued to burn. In the case of the horseman the shank of the lance was supported by a ring open at the top, fixed upon the horse's head, and the horse as well as the man was covered with an iron armor, in order to protect them from any sparks or flecks of flame which might be driven against them by the rapidity of the onward motion, notwithstanding the precautions taken in respect to the direction of the wind *

Of course combustibles carried in this way could not be sufficient in quantity to burn for a long time. It was necessary to calculate the possible duration of the fire very accurately, and to act, after the fires were once lighted, with great promptness and decision. The object of the enemy, it is plain, in case of such an attack, would be to gain time by falling back, or by deceiving the assailants as to the distance, so as to allow the fires time to burn out. One conspicuous example is given in a combat between the forces of the Sultan of Egypt and those of a Mongolian Khan, which took place in Syria, when a body of Egyptians, armed with lances carrying Greek fire, suddenly appeared issuing from the ranks, and advanced across the intervening plain toward the enemy. But they had in some way or other so miscalculated the distance—or the duration of their fires—that the combustion exhausted itself before they reached the Persian lines. The Persian commander then ordered a countercharge upon them. They were thrown into confusion, and in falling back to their own lines carried confusion with them, and their whole army was put to flight.

The marvelous tales which have been told in

Big Brother is Watching Lawrence

By Kurt Saxon

For years I've been accused by the news media of corrupting people, especially the young, by giving them the knowledge to destroy their enemies. Of course, I don't direct such knowledge toward youngsters but they are attracted to the macho publications my ads are in. Luckily, most of those youngsters have the intelligence to realize that deadly force, except in actual self-defense, must be backed up with the wisdom of maturity.

After selling over 50,000 copies of THE POOR MAN'S JAMES BOND, there has not been one report of any youngster hurting himself or anyone else. You can be sure the media would love to smear me with a story of one of my young readers destroying all life forms in his neighborhood. (See "Tylenol Interview", page 65). Even so, it wouldn't bother me unless I lived in that unfortunate community.

Actually, THE POOR MAN'S JAMES BOND is a real deterrent to crime. It forces the reader to accept responsibility for his actions toward others.If he uses it unwisely and is so stupid as to be caught, he can't plead crime of passion, insanity, or any other cop-out. The judge would say, "You ordered it, you used it, therefore it was premeditated, so I'm going to have them lead you off".

The letter I've reproduced below is from one who fears responsibility. His fear of freedom is obvious. He is a tribalist, as described in my editorial, "The Citizen Menace". And rather than turn him loose on society, I've made him tractable and docile, as all tribalists should be.

As in George Orwell's "1984", which I think he's read, I'm his O'Brien, giving him "The Book" which will stimulate his latent urges for freedom. In his mind, the purpose is to seduce him into thoughtcrime. Big Brother is now aware of his unorthodoxy. The Thought Police will eventually pick him up, and in Room 101 of the Ministry of Love, all unorthodoxy will be tortured out of him and he will finally know that, for inferiors, Freedom is truly Slavery and Ignorance is truly Strength.

An obvious teenager, reflecting the lack of intellectual discipline it takes to communicate, he can neither spell nor arrange his ideas in any logical pattern. Read his letter out loud to yourself and see if it doesn't sound like the gibbering of a terrified monkey.

"Dear Mr. Saxon:

I think your poor man's James bond sucks! And all the rest of the books that you publish. I know that you are a agency of the United States. Its totally ridiculous the methods that you employ here. Were taught from very young about history, the government, constitution rights this and that. We learned it all through reading! You read the papers everyday about crime, war, polatics, right! So here you go around wondering about how bad things really are right. So now you get the blues and your wondering what to do. You pick up a magazine and read your advertizement, send for and receive it. Here you read all this nasty stuff, that was of course your ideal and ideals! I would have never guessed how to make this stuff if you havent furnished the information. It seems totally cartrated what this country stands for! It seems you should practice what you preach! I feel I lost my right to privacy. Oh well, stick it in your computer. Your false and misleading advertizment seems to break the law. When you read

respect to the power of the Greek fire to burn under water have a certain foundation in the fact that, in the times when this agency was employed in war, the method of using it was by packing the materials in a spherical receptacle, in such a manner that when thrown into the water the missile could go down to a certain distance without being entirely extinguished, so that on rising again to the surface the flames would break out anew, ready to set fire to any combustible object that they might encounter. The engraving on page 40, copied from one of the ancient illustrations, gives a general idea of this operation. The balls thrown from a height into the water would of course sink below the surface, until brought back again by their buoyancy; and there would be no great difficulty in so storing so very combustible a material as that it should retain the fire during this brief interval

Moreover, if a small quantity of water were injected into a large mass of any combustible material fully on fire, the extinguishing power of the water would be overcome by the quantity and intensity of the heat, and the steam suddenly created would act with explosive force in scattering the burning materials all around. Just this we see on a small scale in a candle, when minute quantities of water in the wick, instead of putting out the flame, only produce a series of spluttering explosions. The explanation of the extinguishment of fire by water is the cooling effect of the water in reducing the temperature of the materials below the burning-point. This effect is due, it is true, not to the simple cooling power of the water as water, but to the enormous amount of heat absorbed by it in being converted into steam.

Of course, if the quantity of water thrown upon a fire is not sufficient to abstract from the fire, by its conversion into steam, heat enough to reduce the temperature of the whole mass of burning materials below the burning-point, it will not extinguish the fire.

The process of combustion consists essentially, in ordinary cases, in the combination of the combustible with oxygen by a chemical action intense enough to develop light and heat. Of course unless air is present, or some other supporter of combustion, this process can not go on. Now the Greek fire, so far as is now known, contained within itself no substance that could furnish oxygen, but was dependent altogether on a supply from without. It could not, therefore, continue to burn when the air was excluded. Nor could it possibly withstand the cooling effect of any large quantity of water applied directly to the burning mass.

The transition from the manufacture of Greek fire to that of gunpowder in war, it is now found, was not the result of any sudden discovery, but grew gradually out of the incidental introduction of saltpetre among the combustible substances, which was found in some mysterious way greatly to increase the violence of the combustion. Saltpetre is a substance which is found abundantly in a natural state in the countries where Greek fire was most used. The mode of its operation in changing combustion into explosion was not probably at first comprehended, as the science of chemistry was then practically unknown. It is now, however, understood that the result is due to the saltpetre's furnishing a supply of oxygen to the combustibles, and thus making them independent of the air in respect to their burning. It furnishes the supply, too, in such a way, to every particle of the combustible, by means of the

magazines like yours, you wonder what the hell is really going on. You make matters that much worst. Even bring out the worst in somebody. Why add fuel to the flame You make matters much worst. Your real cure starts at the community not the media. Now I don't know who to believe or what to believe anymore. I wonder sometimes who's really running this country. Believe half of what you see and nothing that you hear Or read for that matter. I was caught in one of your sting operations, through a magazne ad. It stinks. I've had no criminal record and don't say to your self well he just didn't get caught. Bullshit! You all planted the Ideal! Go find the real criminals and get out from that desk and computer. As for me I'm going back to my normal lifestyle citizen I hope one day when I get older, Our generation will think more about the bible and follow its rules, More so then what our governments based on. "Remember", In God we Trust. Ha, Ha!, I hope one day you all will realize what's going on. Orwellian here we go!

Respectfully Lawrence ----

Now for my translation and/or commentary:

Dear Mr. Saxon:

I think your Poor Man's James Bond sucks! (He disapproves of the PMJB). And all the rest of the books you publish. (Either we lost his order or he ordered from someone else, so I don't know if he ever saw any of my other works). I know that you are an agent of the United States. (He thinks I'm a Federal agent). It's totally ridiculous the methods that you employ here. (The methods I employ to entrap his kind are ineffective). Were taught from very young about history, the government, constitution rights this and that. (We're taught, while young, history, civics, our Constitutional rights, etc.). We learned it all through reading! (By emphasizing reading, he reflects the tribalist's attitude that anything that can get into print is gospel and must be obeyed).

You read the papers everyday about crime, war, polatics, right! (He reads the news daily and is influenced by the negative aspects of life). So here you go around wondering about how bad things really are right. So now you got the blues (the news depresses him) and your wondering what to do. You pick up a magazine and read your advertizement, send for it and recieve it. (He read an advertisement for the PMJB, ordered and recieved it). Here you read all this nasty stuff, that was of course your Ideal and Ideals! I would have never guessed how to make this stuff if you havent furnish the information. (He orders a book on deadly force and blames me for putting ideas and ideals of violent behavior in his mind). It seems totally contrated what this country stands for. (Your ideas seem totally contrary to our national ideals). It seems you should practice what you preach! (I do, but I don't know if he means me or if the statement is rhetorical). I feel I lost my right to privacy. (Someone knows he now has the power of life and death over others so he will be watched from now on). Oh well, stick it in your computer. (If I had one, I'd know if he ordered from me). Your false and misleading advertizement-- (The PMJB is exactly as advertised. But to Lawrence, a practitioner of doublethink, the ad was indeed false and misleading. To the tribalist, all unorthodoxy —seems to break the law. The ad made him believe I was encouraging the implementation of his fantasies of illegal acts). When you read magazines like this you wonder what the hell is really going on. (When he, not I, reads such magazines, he realizes there are overtly unorthodox belief systems and wonders if they are contrived by Big Brother to entrap him). You make matters that much worst. (He would have gotten the world straightened out in time if I or the publishers of whatever magazine he refers to hadn't led him under the scrutiny of the authorities). Even bring out the worst in somebody. (He believes the magazine aroused his primitive instincts). Why add fuel to the flame. You make matters much worst. (Individual preparedness offends the authorities and makes the system more oppressive).

Your real cure starts at the community, not the media. (Any remedial action should be at the community level, by committee. Publishing unorthodox ideas encourages individual action, which is a threat to the collective). Now I don't know who to believe or what to believe any more. (To think for himself is unthinkable. The tribalist must have an authority figure to believe in or he feels abandoned). I wonder sometimes who's really running this country. (Who is my master?). Believe half of what you see and nothing that you hear. Or read for that matter. (Wear blinders and shut out all communications, lest an unorthodox idea creep in).

I was caught in one of your sting operations, through a magazine ad. It stinks. (A sting operation requires a willing dupe set up by one who helps him carry out an illegal act observed by the authorities, or a crook who means to run off with the loot, leaving him holding an empty bag. Since I have no connection with my readers there can be no sting involved). I've had no criminal record and dont say to your self well he just didn't get caught. (He's really a good boy). Bullshit! (Well, maybe not that good). You all planted the ideal! (But what ground was it planted in?). Go find the real criminals and get out from behind that desk and computer. (He really believes I'm THE MAN).

As for me I'm going back to my normal lifestyle citizen I hope one day when I get

fine comminution and intimate commixture of the materials, as to present to every portion of the combustible a portion of oxygen close at hand, and thus increases enormously the rapidity and violence of the action.

There is another important thing to be borne in mind, which is, that a mixture of combustibles with saltpetre, by containing within itself the supply of oxygen necessary for the combustion, and thus making the process independent of the external air, allows of the inclosing of the materials in strong and tight receptacles, so that the gases produced by the combustion may be confined, and so made to exert their vast expansive force—enormously increased by the great heat developed—upon the walls of the receptacle which confines them

The mode in which saltpetre thus operated in promoting rapidity of combustion was not probably at all understood in those days. It was observed, however, by many persons and in many different countries, as a matter of fact, that the admixture of saltpetre with their other pyrotechnic materials greatly increased the effect, until finally an explosive power was developed sufficient for the projection of missiles from the mouths of open tubes, and then artillery began to appear on the field of battle.

Thus the art of producing gunpowder for the purposes of war seems to have been a growth rather than an invention; and so it is not at all surprising that the origin of it has been attributed to many different men of many different nations. It is as impossible, as a distinguished French writer has said, to answer the question who invented gunpowder as to say who invented the *boat*.

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older. Our generation will think more about the bible and follow its rules. (He's going to conform and get right with his mother's god). More so than what our governments based on. "Remember," In God we Trust. Ha, Ha!, (He doesn't believe our government trusts in his mother's god any more than he did when he ordered the PMJB).

I hope one day you all will realize what's going on. Orwellian, here we go! (He believes Orwell's 1984 is near. If you've read "1984" you'll realize that the timid, wishy-washy tribalist Lawrence typifies was the mainstay of Big Brother's INGSOC).

Respectfully, Lawrence ——

(He really thinks I'm THE MAN

Lawrence's traumatic reaction to the PMJB reminds me of an incident of my boyhood. I was walking along the dirt road near my home outside Elmhurst, Illinois. With me was my dog, Dumbo. As we passed Clyde Webster's home, his little dog, Rags, came out of his house and commenced barking furiously at Dumbo. Dumbo took no notice, as Rags was a chained dog and, therefore, beneath contempt.

Standing on his hind legs, straining at the chain, Rags grew bolder in his insults. Dumbo plodded on, staring straight ahead. Infuriated at the larger dog's refusal to do battle Rags strained harder and the chain broke. Freedom! Now he would thrash his haughty foe.

But freedom was a heavier chain for Rags. Freedom brings responsibilities known even to dogs. Freedom meant he would have to back up his c onvictions with teeth. So, almost as if he were playing a role, Rags actually put his little tail between his legs and slunk into his house, hoping against hope that Dumbo wouldn't notice he was free.

Lawrence is free. He still has the book. But lest anyone take notice of his freedom, he's going to get right with God and try to hide the fact that he ever strained at his chain.

But in his mind, Big Brother is watching him and he will love Big Brother for the rest of his life.

Knife Throwing — for Fun & Self-Defense

It's merely advanced mumbley-peg, but there's a practical side to this fascinating pastime

By F. C. NESS

OUTDOOR LIFE — DEC. 43

Start of the power throw. The heavy knife is on its way back to a point behind the shoulder

Form is all-important. Here the author demonstrates the correct technique of a handle-hold throw

LOOKING back at the glamorous pageant of pioneer days, the hunting knife stands out in bold relief. Along with the rifle and the ax, this weapon of our forefathers played a most important part in the early history of America.

Thirty years ago I became interested in these knives—I wanted to know how the frontiersmen threw them. But search as I did, I could find no published work on the subject; and I don't believe that any exists today. I had to learn my knife throwing by experiment.

Knife throwing is a fascinating pastime. Your arm swings back, steel flashes through the air—and *zip!* the blade quivers in the target. Properly thrown, the knife

hits hard and bites deep in businesslike fashion. Making the point stick nearly every time, and at various distances, requires a lot of practice; but practicing—on the trail, in camp, or at home—is fun.

There's a practical side to this exciting diversion, too. Porcupines and other small game have been impaled on the thrown hunting knives of hungry, lost campers. And skill with a heavy knife has doubtless saved more than one soldier's life. Signal Corps movies from the Solomons show our marines throwing knives on captured islands, and recent news photographs show our Raider and Ranger trainees practicing the art in groups.

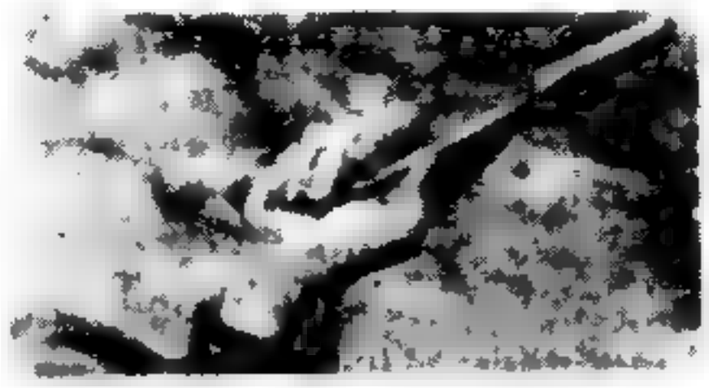
When practiced as a backyard pastime, knife throwing is merely advanced mumblety-peg, easily learned by anyone. Any light-handled knife—a kitchen knife, for example—can be used, and a heavy cardboard carton will serve admirably as a target.

Stand about three feet from the target, right foot forward. Hold the knife by the blade, point between thumb and forefinger,

Top of the power throw. Arm is all the way back, in position to hurl the knife forward and overhand in a mighty swing

Finish of the power throw. Arm fully extended, and pointed at target. Release is smooth and rhythmic

fist naturally closed, and flip it overhand from near the ear, straight at the target. If the knife does not land point first, move a step backward, and throw again. You are trying to find the distance at which the knife will make a half turn in the air and strike point on. When you have found it, practice a uniform delivery until you can make your knife stick every time.



For long power throws the knife is reversed, and finger extended along flat side of blade

Another variation of this throw has the index finger extended along the knife's safe edge

For slightly longer distances another grip is more effective. The blade is again held by thumb and forefinger, but this time the thumb is extended along the flat of the blade, and the knife is released with the thumb pointed directly at the target. This grip gives a slower half turn to the knife.

To throw from a distance of about ten feet, hold the knife flat in your palm, with the blade pointed toward your elbow, and your finger against the handle. Throw it overhand, and let it slide out, handle first, with your extended hand pointed squarely at the target.

Throwing knives. Top is a Victor Forge hunting type. Next, two Couteau Gene circus knives. And below, three of Victor Forge's throwing models

For distances of from twelve to fifteen feet, take the handle of the knife in your fist, extend your thumb, and let fly with the same short, overhand flip that you used for the blade holds. At about this distance, and with this throw, the knife makes a complete turn in the air.

These four throws are basic. Practice them until you have developed a smooth, rhythmic technique for each. It is useless to attempt long throws until the proper form has been mastered, and you can make the knife land point first at distances up to fifteen feet. When you can do that you will find that by doubling the range of the handle-hold throw, and trebling the range of the three other throws, your knife will again land point first.

While great skill can be developed through practice, knife throwing is not an exact science. No two persons throw precisely the same, and since the knife somersaults in the air, a beginner must find his proper ranges by trial and error. Form is the secret of success with knife throwing. You can use various throws for different distances, but the technique of a given throw must never vary.

My interest in knife throwing was stimulated some time back by a gift of a pair of beautifully balanced circus knives from Eugene Stebbings of Freeport, Ill. Eugene, better known as Couteau Gene, rode herd and followed a chuck wagon before he could raise a hair on his upper lip, and he is no slouch with gun or knife. At short range, with six of his knives in his left hand or in a hip quiver, he can stick them all in a six-inch circle, one by one, as easily and nearly as fast as he can shoot into the same circle with his revolver. Twelve years ago, he was designing and making knives for Tex Worl of the Ringling Brothers circus. The knives he gave me were a foot long, and weighed nine ounces. Forged from one piece of special steel, they were flat and thin, but perfectly tempered to withstand the abuse of hard throwing. The handles were straight, the edges of the blades dulled to permit the blade grasp.

The Couteau Gene knives are fine for accuracy. Like most throwing knives, they are balanced just forward of the handle, and their symmetrical shape contributes to a uniform delivery.

Missiles of this weight require a wooden target at least three feet square, and made of boards an inch or more thick. I made mine six feet high,

The first of four basic throws. The pinch hold on the blade of a light-handled knife

four feet wide, and used two-inch cypress planks. Before throwing, I soften the target with the hose and plenty of water. Also, while practicing, it is a good idea to hang a burlap bag containing excelsior, grass, or straw over

Second, the pinch hold with thumb extended. This gives a slower half turn to the knife

the target; for some of the knives are bound to land flat, and such a cushion will prevent snapped blades and split handles. Set the target behind the garage or some other high backstop, so as to keep your knives in your own backyard, and yourself out of a damage suit. A heavy knife is a formidable weapon in flight, so be sure that there is no chance of its hitting someone, even if it glances off the target. And don't throw, ever, at a living tree.

Just before the inexorable demands of the war stopped the manufacture of so many sportsmen's items, a new throwing knife, made by Victor Forge of Erie, Pa., appeared on the market. The four I own are nine inches long, and weigh 6½ ounces each. Made in one piece, like all good knives, they have short narrow handles and long spear-shaped blades. They are flat and dull edged, but balanced well forward of the handle. For pleasure throwing, particularly for handle holds, and for rapid-fire grouping, these knives are hard to beat.

I have other Victor Forge knives—hunting style, with a razor-sharp edge and a small projection or guard near the handle. But the balance is there, and except for the blade holds these

Third, the palm grasp for distances of about 10 ft. Here, knife slides out handle first

knives can be thrown exactly like my throwing models.

For self-defense, such a knife is held

Fourth, the handle held with thumb extended. This throw is for distances of 12 to 15 ft.

in the fist, with the blade inclined forward and the cutting edge up. In this position it is ready for belly ripping or sticking under the ribs from below the opponent's guard. It is also ready for throwing. And this is the very hold I use for short power throws. When thrown with my right hand, one of these knives makes a complete turn in the air and lands point first at about seventeen feet. Thrown with my left, it turns once and sticks at about twelve feet.

In all power throwing, and especially in combat work, the purpose is to hurl the knife with the greatest possible velocity. So stand with your *left* foot forward (instead of the right), extend your knife arm all the way back, and sweep it forward and overhand in a mighty swing. Get your weight behind it and, most important, follow through. The release is the same as in the other throws—a smooth rhythmic slide from the hand.

For serious combat practice, concentrate on this throw. Find the approximate distance at which your knife will make a complete turn, and practice until you can make it stick every time. Eventually you will be able to make your knife revolve once, twice, or even three times, and still land point first—with a thrilling, deep-biting thud.

For accuracy in the longer power throws, I reverse the knife, and extend my index finger along the flat of the blade, or along the safe edge. This gives the knife a slower turn, and makes it easier to strike a distant target point first Using the short, twelve-ounce Enfield bayonet, I can drive its eight-inch blade deep into a target at thirty feet—which I consider the maximum distance for practical power throwing

Once you have learned to make your knife land point first at various distances, you will be surprised at how closely you can gauge the range with your eye. You will want to hurl your knife into every sand pile, clay bank, dead tree, or stump. I know I do. Unconsciously, you'll pick out some likely-looking target, note the dwindling distance, and let fly when the range looks right. And nearly every time it will be.

By using the handle hold, with thumb extended, these knives were thrown from exactly 12 ft.

PIPE SHOOTS THROUGH ITS STEM

Popular Science Monthly — 1933

Though innocent enough in outward appearance, a novel type of firearm disguised as a smoking pipe serves as a formidable weapon when it is needed. The gun fires a .25 caliber cartridge. Its stem unscrews for loading, while the bowl of the pipe serves as a magazine for five extra rounds of ammunition. A knurled screw near the center serves as a trigger, and fires the pipe pistol when it is pulled back as illustrated in the photograph above, the user sighting meanwhile along the length of the stem. A German inventor is responsible for the unusual weapon.

The Wallet Pistol

By Kurt Saxon

The wallet pistol is about the best defensive weapon I've come across. An ex-cop who sold me mine said he'd been searched and it had been passed over.

There would be little reason to fear it being detected in your hip pocket. The only way anyone would know would be if you spread the word around and someone told the law you were carrying it.

If you should adopt the weapon you should make sure it projects a half inch or so out of your pocket. Otherwise, it will snag on the sides of your pocket and be hard to withdraw. Snagging is prevented by measuring the wallet and sewing the pocket across so the wallet won't go out of sight.

To use, wait until some dummy demands your wallet, then take it out and shoot him at least twice.

The gun shown here is a High Standard, .22 caliber magnum Derringer. It holds two shots and can be fired one after the other in rapid succession.

There are other .22 Derringers on the market holding regular .22 long rifle shells. Hollowpoint Stingers are just about as effective as the magnums and those Derringers are considerably smaller.

The wallet shown here was made by a custom leatherworker. If you have a friend in the business you can get it done professionally. Otherwise, you can pick up a wallet kit at any craft shop and do it yourself.

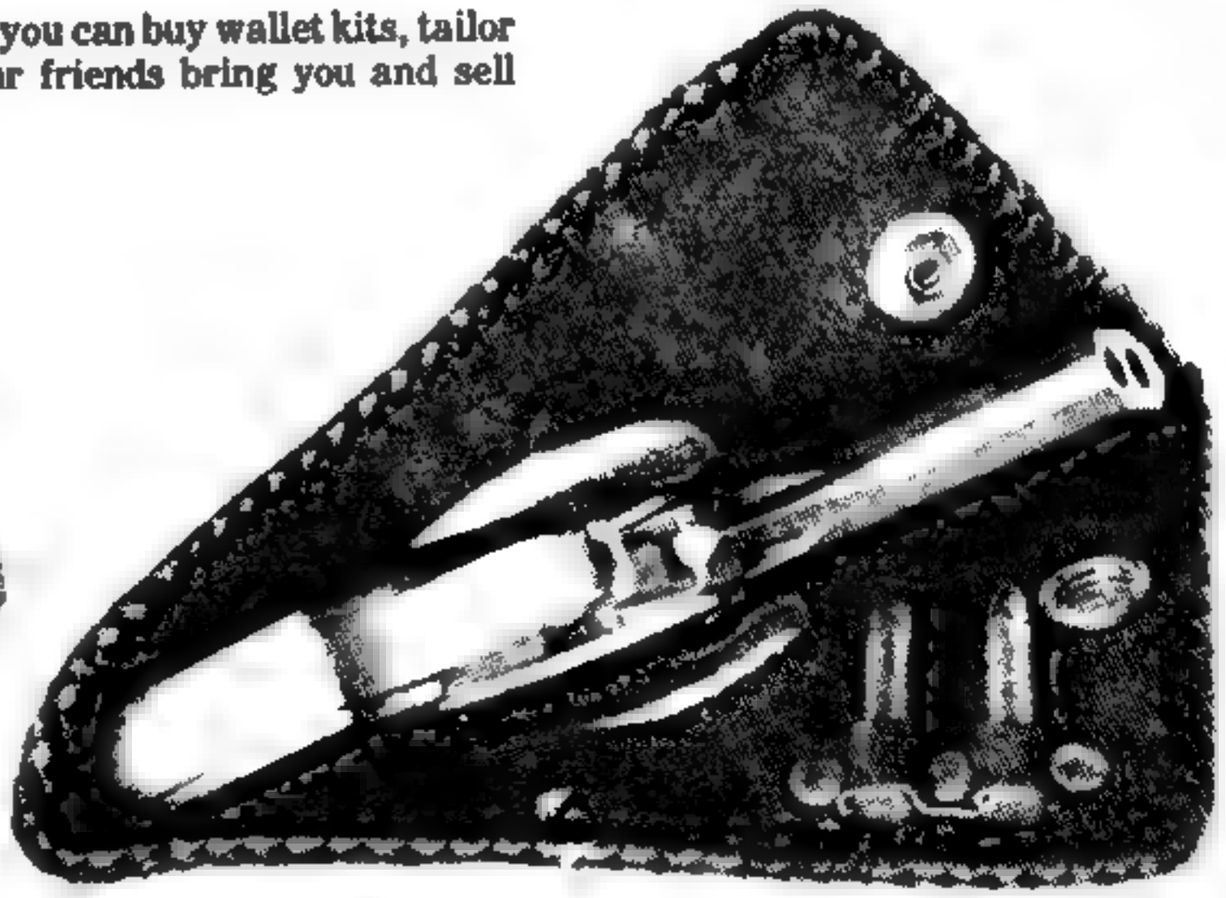
When you buy the wallet, discard the insides. Get a set of snaps from the hardware store and put one just under the barrel so it doesn't drift around inside. Lace or sew the top corner of the wallet shut to further hold the barrel.

Remove the grips from the pistol. Punch holes in the wallet over the holes where the grips are screwed on. Then just put the pistol in and screw the wallet tightly to the handle. The holder for extra bullets is optional.

With a razor knife, cut finger holes on both sides to reach through to the trigger.

To reload the pistol, just unsnap the wallet and swing the gun down.

If you are profit minded, you can buy wallet kits, tailor them to fit the pistols your friends bring you and sell them for $50.00 each.



The Versatile Hypodermic Needle

By Kurt Saxon

I suppose you've seen films of dopers shooting up with a hypodermic needle fitted to a medicine dropper. The impression was that the needle was precious and hard to come by. Forget the hypodermic. All dope paraphernalia was strictly underground and illegal.

Since I have several pets and have to go to the vet frequently, I took to asking for the used hypodermics and needles used on my animals. The vet handed them over and I thought I was really getting away with something. I had told him I wanted to use them for injecting chemicals in plants.

I would take them home and store the needles in a test tube full of rubbing alcohol to keep them from clogging up.

A while back I heard of a self-injecting device for diabetics who were too squeemish to jab themselves. I bought one from my pharmacist. It was no good since it only pushed in the needle but didn't work the plunger.

I had no intention of sticking myself and, without the double action I'd counted on, it was useless to me. But in the meantime, the pharmacist took it for granted that I was a diabetic and sold me some needles. They weren't the right size for the device but I had a lot of fun playing with them.

When the pharmacist asked me what kind of needles I normally used I told him I wasn't a diabetic; I just wanted them. He didn't blink an eye and sold me 100 3 cc diabetic hypodermic needles in separate packages at 17 cents each, or $17.00.

Like I've said before, when a person makes his living by selling something, he wants to make a sale, especially in these hard times. So if you don't have every appearance of being some kind of freak, all you've got to do is hand over the money and you've got the product.

Eventually, I intend to get several cases of various sized needles for barter later on. They will bring high prices from doctors who didn't stock up.

Of course, they are meant to be disposed of after one use. Many disposable hypodermics have the needles built in as opposed to those whose needles can be taken off. Either way, they can all be stored in alcohol after each use and so can be used hundreds of times.

Fine emory paper can be used to sharpen them occasionally. The dosage markings are usually on the inside and rub off with use. But the markings can be put on by hand on the outside with a small file by the doctor when the inside markings begin to dim.

A few cartons of hypodermics could set

Tylenol Interview

By KURT SAXON

The Tylenol murders gave rise to a classic example of mass hysteria. It should have been obvious from the beginning that the poisoning was restricted to a small area in Chicago and done by one sub-human. But it led to all the Tylenol in the country being yanked off the shelves.

Consider the average sub-human living in the anonymity of a city. He'll never be known for anything positive. But such a wimp wants to feel important, even in a negative way. He wants to be an effect, even if he's the only one who knows about it.

So he puts powdered castor beans in a hotel's air conditioning unit, causing Legionnaire's Disease, or puts razor blades in Halloweeners' apples or cyanide in Tylenol or acid in Visene or some other poison in Lavoris mouth wash.

The overreaction of the FDA, the news media and the manufacturers of the polluted products give the inferior a feeling of power and importance he could never otherwise achieve.

Instead of suppressing such stories until the sicko has been nabbed or the incident can be put in its proper perspective, the authorities and media run off in all directions, causing panic and loss with no more sense of social responsibility than the sub-human who started it all.

In the general grasping at straws, Chicago's own Roger Arnold was a suspect only because a fink said he had some potassium cyanide, (which he didn't) and some unregistered guns. A search turned up a copy of THE POOR MAN'S JAMES BOND, which has instructions for making potassium cyanide.

The media naturally publisized the PMJB, which was great for me. In their witch hunting spree, they also tried to shift society's responsibility for its degenerates to one who merely published a book telling how to defend oneself against those degenerates. Hence, the Democrat interview.

The Arkansas Democrat is the National Inquirer of the Ozarks. Incompetently staffed and poorly written, it caters to simpletons too dull of intellect and debased of ego to demand accuracy in newsgathering.

In 1980, Dan Wiseman, an effiminate nebbish, libelled me and killed the Democrat's chances of ever getting a straight story concerning my aims or views. When Margie Law phoned for an interview, I realized whatever I said would be distorted, exaggerated and/or taken out of context. So I gave her the most outrageous line of bull I could come up with. Many a truth is spoke in jest so I leave it to the reader to separate farce from seriousness.

The taped interview:

(Arkansas Democrat) "Hello, this is Margie Law of the Democrat. Is this Kurt Saxon?" (Kurt Saxon) "Yes." (Dem.) "Have you heard of Roger Arnold, who works for the Jewel grocery store chain?" (KS) "Yes." (Dem.) "They found some books in his apartment that were written by you." (KS) "Oh yes, THE POOR MAN'S JAMES BOND." (Dem.) "Right." (KS) "Yes, that's a primer for killers. Anyone can murder anyone with that book. And I endorse it and I promote it. I think if you have THE POOR MAN'S JAMES BOND you can kill anyone you want. That's a great thing."

(Democrat) "Okay, you endorse it. You think he used that?" (KS) "I don't know but I think he could have. I don't know the man. I don't even know if he bought the book from me or one of my dealers." (Dem.) "Where are they distributed, Kurt?" (KS) "Well, people write for my free catalogue and send the money and I send the books. And I have dealers around the country." (Dem.) "In the Chicago area?" (KS) "No dealers in the Chicago area."

(Democrat) "So you don't know this guy personally." (KS) "Oh, no. I don't know my customers. I don't want anything to do with my customers. Especially those from Chicago

you up in the medical supply business and make you a hero, too.

Aside from eventual barter, the hypodermic needle can come in handy in many ways. You say your squirt gun leaks? Well arise and get yourself some hypodermic needles. They don't leak and shoot a powerful squirt several feet. You might think a hypo would give only one good squirt but up to 20 good squirts can be gotten from a 3 cc hypo.

You just point it at one or more targets and go bip, bip, bip, bip, with your little old thumb. Practice helps but a lot isn't necessary.

If your only purpose is to use the hypo as a squirter, it would be best to take a pliars and bend the needle back and forth to break it off. It isn't needed and you wouldn't want to accidentally stick yourself.

If it is to inject an unsuspecting enemy you'll want the diabetic needle as it is the thinnest and shortest. In the excitement of an altercation, your opponent would not notice he had been injected. One quick jab, a little scuffling, and he would drop dead.

The diabetic needle is also best for injecting an enemy's rump while he's sitting on a bar stool. If you should give him a hearty slap on the back he'd probably be distracted into not feeling it at all. If he did, it wouldn't hurt and he still might not suspect he'd been attacked.

A quick thrust and plunge into the rump of a walking or standing opponent would hardly be noticed, especially by passersby. Keep moving, anyway. You must be aware, however, that no more than 1 cc should be used for a lethal injection. The reason for this is that the victim will probably withdraw reflexively. Even so, the injection of only one half a cc is almost guaranteed to be fatal if you've done your homework. Practice on a pillow.

Since the diabetic needle is the smallest and sharpest, it is also the most fragile. That's why you must practice a straight thrust into the naked arm, throat or some part of the body covered with tight fitting material, like the rump. Otherwise the needle will bend. Even so, in the next issue I'll detail a device that insures a straight thrust, even through relatively thick material.

Lest you think carrying hypos around would be awkward and fear sticking yourself while it rests in your pocket, don't worry. Each hypo comes with a long, plastic cap, like a holster. The beauty of this cap is that all you have to do is stick a safety pin through its tip and

since it's a documented fact that came over the TV last night that there are seven million people in the Chicago area and six hundred thousand of them are disturbed. So that's nearly one out of ten dingbats in that city and I don't want to live there. And I wouldn't put it past any of them to do anything to any of the rest of them. So I'm not at all surprised.

"And, of course, THE POOR MAN'S JAMES BOND is primarily to wipe out the sub-human populations of the cities. So the more books I can sell to people in the cities, the happier I am about it." (Dem.) "So the purpose of your book is to wipe out the sub-human populations of the cities?" (KS) "Yes, that's right. That's the only legitimate purpose for such a book as that."

(Democrat) "Okay. But what do you mean by 'sub-human population'?" (KS) "Well, urbanites, as far as I'm concerned, are all sub-human. No one in his right mind would live in a city, anyway. I'm a rural type, see? I'm a hill person."

(Democrat) "Kurt, are you a Survivalist?" (KS) "I am THE Survivalist. I coined the term." (Dem.) "What does that mean?" (KS) "Well, a Survivalist is a person who realizes civilization is about to collapse and wants to get out from under it."

(Democrat) "Are you working on any other books?" (KS) "I'm working on THE WEAPONEER right now, which picks up where THE POOR MAN'S JAMES BOND leaves off. It tells how to make ricin, potassium cyanide grenades. The last issue told how to make cyanide smudge pots but there was a typographical error so I don't think my readers will understand it until I correct it next time."

(Democrat) "What did you think of the Tylenol murders?" (KS) "Well, that isn't really my way of doing things. I would have asked for money before I did anything like that. He didn't get any money out of it and people think he's a bad person now. So why be hated any more than you are otherwise if you're not being paid for it?"

(Democrat) "Kurt, he's just a suspect. They don't really know if he did it or not." (KS) "They'll never catch the one who did it." (Dem.) "Don't think so?" (KS) "Of course not. How could they? All you have to do, sweetheart, is to go into a store, buy some product, take it home, doctor it, take it back, put it back on the shelf, and how is anybody going to trace it to you?

What you ought to do is send the doctored product to the manufacturer and say, 'Listen, I'm going to put a dozen of these on the shelf if you don't send me some money, or put it in my bank account,' like that one extortioner did. But he didn't even do that. He just said, 'Put the money in my bank account or I'll start poisoning your product.' He ought to have sent a sample of the doctored product.

"For instance, say that you should buy a bottle of Head and Shoulders and empty it half out and fill it full of Nair and shake it up and send that to the manufacturer and say, 'You try it on a dog and after you see your bald dog, imagine what's going to happen if I put a dozen of these in The Elite Shop and get all these rich broads and they come out of the shower, just bald as an egg, and they're going to sue you out of existence, see?' So that way you could get money. But just to poison people or mess up their lives, willy-nilly, there's no profit to that."

(Democrat) "Do you know if he had any of your other books?" (KS) "I don't know. I hope he has because I like to sell as many as possible." (Dem.) "Do you keep records of people requesting your books?" (KS) "Well, there are records but I wouldn't bother to look it up because that's customer privacy. I wouldn't want people to have the idea that I'm going to turn their names over to the authorities just because they want to poison somebody."

(Democrat) "Would that book have been helpful in doing the cyanide poisoning of the Tylenol?" (KS) "No, it doesn't have any relation to how you use it. It just tells you how to make potassium cyanide. You have to determine how to use it yourself, because I'm all for letting a person think for himself. I'm not going to think for anybody. I'll tell you how to make it and then you decide whether you want to do it and how you want to apply the knowledge. I'm just a teacher."

(Democrat) "Have you been contacted by anyone else about this?" (KS) "Not any authorities or anyone like that. Mainly by people who want to buy THE POOR MAN'S JAMES BOND. I've been getting calls from all over the country and I suppose I've made quite a profit out of it. They say it's an ill wind that blows no good." (Dem.) "You've made a profit out of the story?" (KS) "Oh, I'm cleaning up. Besides, I didn't know those seven people,

pin it to the inside of your clothing.

One way is to put the cap down into one corner of your shirt pocket. Then stick the pin in through the back of the pocket in the inside of the shirt. Thrust the pin through the tip of the cap and back through the pocket and close it.

Now just stick the hypodermic's needle into the cap and you will have a weapon secured and safe until you need it. All you have to do is yank it out when needed and replace it when finished.

For the shirt pocket hypo, the 3 cc weapon should be only 1 cc full. This way, only a little of the hypo is exposed to view and no one will notice it or suspect it for what it is.

If you want a real arsenal, you can pin any amount to the inside of your jacket and just let them hang downward. The caps hold them securely, with no danger of them coming loose. They can have a full 3 cc load. Just make sure when yanking them out of their caps that you have the presence of mind to grasp them by the tube rather than the plunger.

Since the caps are impervious to anything washing or the cleaners can do to them, you might consider attaching them with thread and leaving them in your pockets or coats permanently.

Don't plan on filling a hypo and carrying it around for days. Although the cap keeps air from the needle, you don't want to take a chance on the contents congealing in the needle.

If you adopt this weapon, plan on emptying the contents back into their normal container every night. Then fill them with alcohol overnight and shoot it back out each morning before reloading. In this way, the needle should be free from any stoppage for as long as you want to use it.

A very practical use for hypos is for filling small-mouthed containers. There are seldom found funnels small enough for tiny containers and so the hypo is the most practical for this purpose.

Scientific American — July 27, 1861

[redacted]

All the army rifled muskets which we have examined appear to have too light barrels. In this feature they resemble the Enfield rifle. We are aware that a certain length of rifle, with bayonet affixed, is necessary for charging and receiving charge; but an improvement may be effected without reducing the total length of rifle and bayonet combined. Take three inches from the length of barrel, and add the weight of metal that would thus be removed to the diameter of the barrel; this will increase its strength, insure more accuracy of aim, and enable the soldier to handle it more easily. The bayonet may be increased in length three inches without adding a single ounce to its weight; and by using the very best of metal its strength will not be diminished.

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anyway.

"Then again, that's one in a million. So that's not bad odds. And they might have been the nearly one out of ten who were nuts."

(Democrat) "Well, thanks a lot, Kurt."

Extraordinary

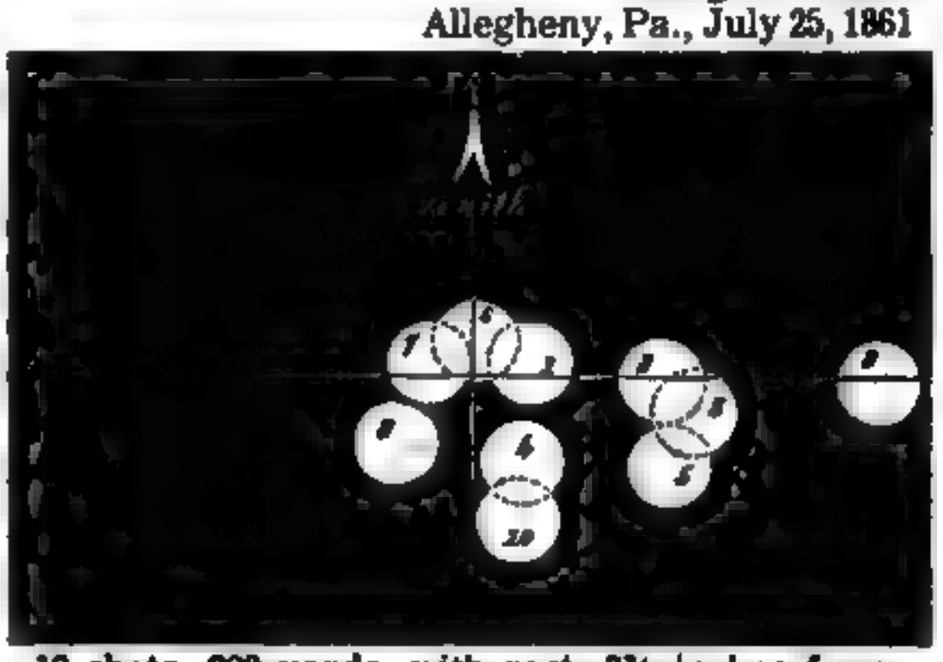
Rifle Shooting.

Messrs. Editors: — I send you a diagram of shooting made in this place on Wednesday, the 24th inst. Hearing of Berdan's great shooting, I thought I would send you a sample of "shooting as is shooting."

These shots were made precisely as drawn, and can be done again. If physically capable, I would join the regular corps of riflemen. If allowed to go upon my "own hook," under the government employ, I would do such services among the rebel officers as would save thousands of useful lives. I am a locomotive engineer, getting $2.50 a day, but I would throw up all, if I could do so satisfactorily.

Shooting men will appreciate the accuracy of the target I send you, and there are many here who would like to see it published. If of sufficient interest I would be pleased to have you do so. I would refer to my master mechanic for the reliability of.

Your obedient servant,
George N. Miller
Allegheny, Pa., July 25, 1861



10 shots, 200 yards, with rest. 8¾ inches from center of shots to the center of the target; or from edge of ball to center, an average of 3-5ths of an inch. — Rifle by James, of Utica, N.Y. — Shooting by Geo. N. Miller, of Allegheny City, Pa.

The Cyanide Smudge Pot

By KURT SAXON

For guarding the homestead, stopping traffic and attacking enemy installations, you can't beat the cyanide smudge pot. It is the simplest, cheapest, quietest and least destructive of property.

If an armored column were approaching your holdings, why blow it up and waste so much good material? If marauders are sneaking around, why take any chances of getting shot? When attacking an enemy installation, why alert their personnel with gunfire?

The cyanide smudge pot is the poor man's neutron bomb. It's very simple and if you have the sense or the opportunity to use wind direction, you can not only protect yourself from any land attack, but can take your opponent's equipment with impunity.

Potassium or sodium cyanide can be purchased from many chemical companies rather cheaply and in bulk. If you don't care to buy it ready made you can make it yourself from easily gotten, less complex chemicals. Its simple manufacture is described on page 92 of THE POOR MAN'S JAMES BOND Vol. 1.

To make a cynide smudge pot, all you need is a tin can of whatever size seems suitable. Fill it half full of cyanide and place it where the wind will blow th egas toward the objective. Place it as close to the objective as possible without being detected.

To use, pour one part by volume of sulphuric acid into two parts of cyanide. Then get away fast. The gas will immediately billow up and flow downward.

Only a whiff or two is sufficient to kill any humans or animals in its path. After a few minutes to an hour, depending on windspeed, it will be safe to walk about the area, enter any structure or vehicle in the path of the gas.

Nest issue will feature cyanide hand grenades.

The Scientific American — Sept. 21, 1861

WHITE GUNPOWDER.

There is an article upon the above subject by M. Pohl, a German chemist, in the London, Edinburgh and Dublin *Philosophical Magazine* for July last, and another on the same subject in the *Chemical News*, Aug. 24th, by F. Hudson, Esq. Considerable attention has lately been given by some chemists to this peculiar substance. The former states that prussiate of potash 20 parts, sugar 23 and chlorate of potash 49 parts, make good white gunpowder. In exploding this powder, 100 parts of it yielded 47·44 of gaseous products and 52·56 solid residue. Ordinarily black gunpowder furnishes only 31·38 of gaseous products and 68·06 of solid residue. The efficiency of gunpowder is measured by the gases which are produced from it by explosion. An equal weight of white gunpowder will produce 1·67 times the explosive effect of the black. In order to obtain the same effect on projectiles and in mines, only 60 parts of white power will be required for 100 parts of the common kind. The residue of the white being as 31·53 to 68 of the black, it is more cleanly, while the heat generated when it is ignited is much lower; and a greater number of shots can be fired with it without heating a cannon.

M. Pohl considers that white gunpowder, being more energetic in its action than common black powder, it approaches more nearly gun-cotton for efficiency, and it has the advantage over this substance in being more easily prepared, keeping for a longer period of time without change, and is cheaper. This powder is not only easier of preparation than the old, but it may be made in a few hours in great quantities with very simple machinery. M. Pohl states that it is difficult of explosion by pressure and percussion; but Mr. F. Hudson, in his communication to the *Chemical News*, states that he made several samples according to M. Pohl's receipts and found that when he mixed the materials moist, then dried them at 150° Fah., the powder was very liable to explode with friction—it was indeed percussion powder. This was not the case when they were mixed dry. He says:—"A cannon loaded with white gunpowder goes off on the application of a few drops of sulphuric acid applied at the touch-hole. The property of this gunpowder may possibly be applied to some advantage in the preparation of bomb shells for long ranges. These shells would not explode until they strike the object, if filled with white powder, and contain a small glass vessel with sulphuric acid. No explosion of the shell would take place in the air, as is too often the case with the ordinary fuse shell."

As this white powder contains a very large amount of the chlorate of potash, it will corrode the locks and barrels of rifles more rapidly than common gunpowder. It, however, may be used as a good substitute, if saltpeter becomes scarce and high in price. It will also require to be handled with more care, as it is liable to explode with severe pressure. We have exploded it easily on an anvil by a blow with a hammer. As it is very cleanly we would prefer it to black powder, and it may yet be so manufactured, we believe, as to become a substitute for it, for most purposes.

The Scientific American — July 2, 1861

BLASTING BY ELECTRICITY.

The following illustrated description for conducting blasting operations by electricity is, in substance, taken from the Calcutta *Engineer's Journal*, and will be found very useful and interesting to many of our readers. It is best adapted for large blasts, as it would be rather expensive in comparison with the fuse, for common operations, such as blasting small rocks:—

PREPARATION OF CARTRIDGES.

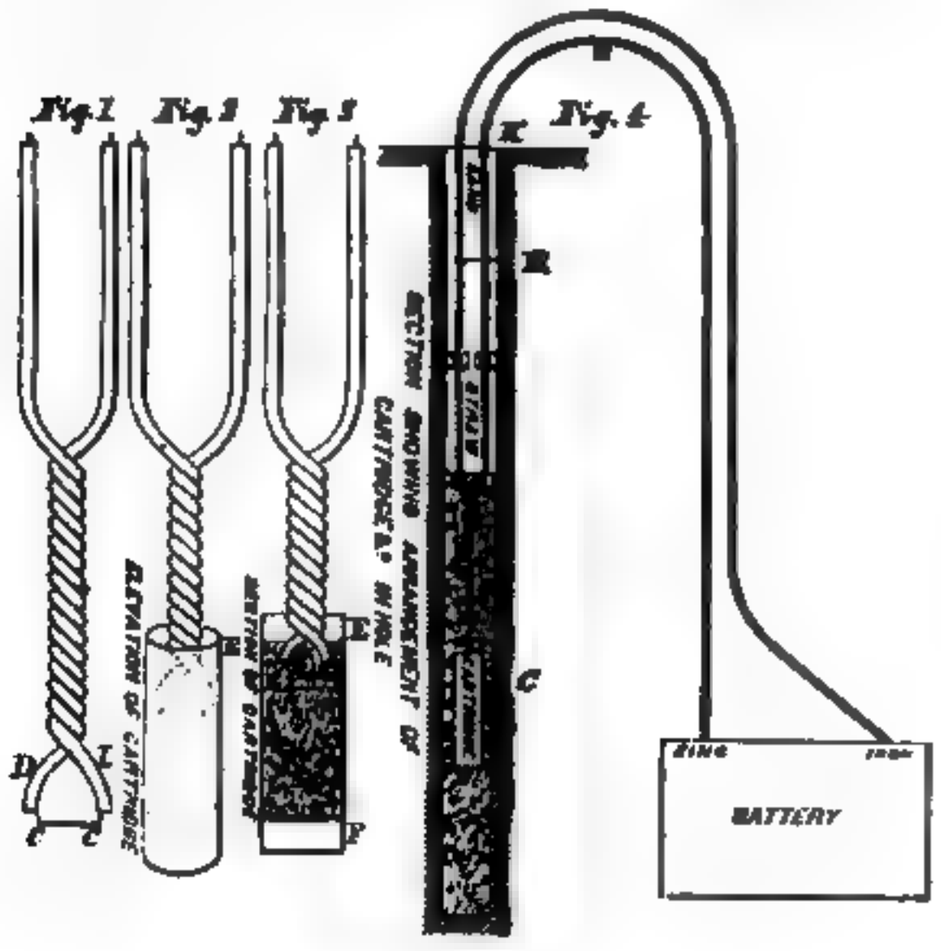
Take two copper wires covered with gutta-percha of the ordinary size employed to make the connections of telegraph instruments commonly called No. 0 gutta-percha wire. They may be of any length most convenient from 6 inches upwards. In the annexed drawing, Fig. 1, they are shown for convenience sake to be only about 6 inches in length, but it would be preferable to have them sufficiently long to project out of the hole a few inches above the surface of the ground, because then no fears need be entertained of any derangement to the connections made with the two battery wires to the two ends, A A, Fig. 1, during the process of filling in the hole, which derangement would injure the insulation and nullify the action of the battery. It should be observed here, that in cases where the shorter wires are used, it will be necessary, after making the connections with the battery wires, to cover the connections over with thin sheet gutta-percha (or paper would do, if the hole is perfectly dry) so as to insulate them perfectly from each other and from the earth. B B, Fig. 4, will illustrate the manner in which this is done.

Let the two wires first mentioned be twisted together for a length of about 8 inches, as shown in Fig. 1, care being taken to leave their lower extremities, C C, free for about an inch, separating them about half an inch from each other. Remove the gutta-percha covering for a length of about a quarter of an inch, as shown at, C C, Fig. 1, and brighten up the ends with sand paper, and then stretch across them a very fine iron, or better, platinum wire (also previously brightened up with sand paper), twisting it round the copper wires, and fixing it in the manner shown in the figure. The upper extremities of the two wires, A A, are also separated, and the gutta-percha stripped off for about an inch, for the purpose of connecting them to the two wires which are to proceed to the poles of the battery. If these connections, owing to the shortness of the wires, are to come within the hole, great care must be taken to insulate them from each other and from the earth in the manner already explained and shown at B B, Fig. 4. Fig. 2 shows the body of the cartridge, which consists of a tin tube 3 inches in length and three quarters of an inch in diameter, the joint being well soldered in

order that it may be impermeable to water. On introducing the wires into the tube they should be placed in the center, as shown in Fig. 2, and great care should be taken to prevent the two wires from touching the outside of the tube anywhere. To guard against this most effectually, the two ends should be opened out and then turned inward again, as at D D, Fig. 1, so that the gutta-percha shall press well against the sides of the tube; thus removing all possibility of the exposed ends of the wire coming into contact with it. The two wires are passed through a cork, and fitted firmly to the upper end of the tin tube, as shown at E E, Figs. 2 and 3, and made perfectly water tight by being covered over with a cement composed of two parts beeswax and one part resin. The tube is then filled with powder at its other extremity F, which is likewise stopped with a cork and cemented in the same manner. Fig. 2 shows the manner in which the cartridge is placed in the hole, after having carefully expelled all dust and moisture, great care being taken that the cartridge is situated in about the center of the charge of powder introduced into the hole, as shown at G, Fig. 4. Above the powder is placed a plug of straw, dry grass, or tow, shown at H, to allow, between the powder and the filling in, a small space filled with air, and above the plug dry sand is poured in until the hole is filled up to the surface, as shown at K. The two ends of the wire then, z I, which projects above the surface of the ground, are connected with the two poles of the battery by means of insulated conductors of sufficient length to allow of perfect protection from any dangers arising from the explosion. The greatest caution should be observed in not connecting the two wires with the battery until the moment the explosion is required to be made, as the effects are instantaneous. If necessary, a number of shots can be fired together, either simultaneously or in such rapid succession as to be all but simultaneous.

[illegible]

The battery best adpted for igniting the cartridges is Callan's battery, commonly called the "Maynooth

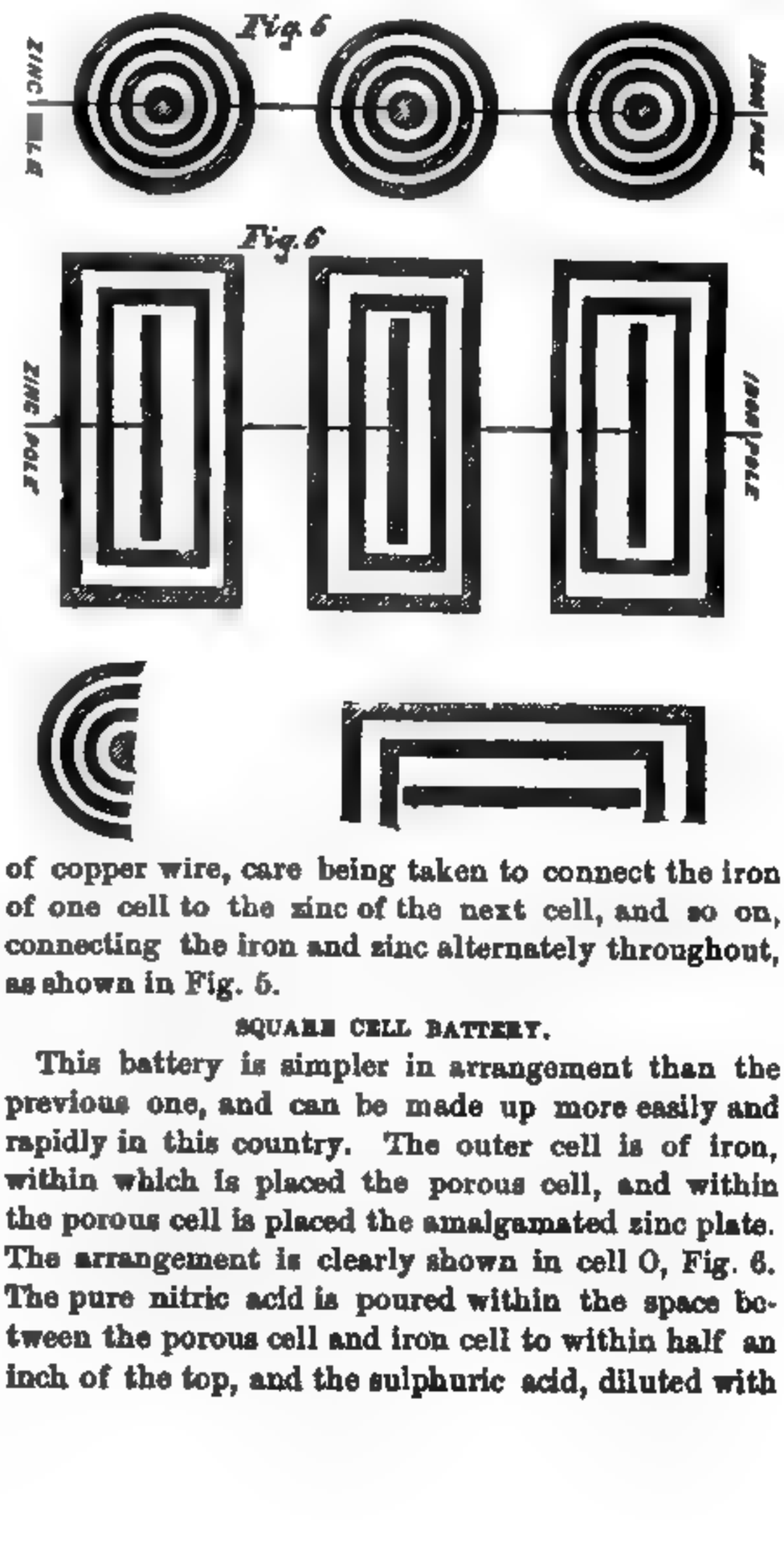


Battery." This is the simplest and cheapest form of battery, and can be most readily made up in India. It is very powerful, fifteen cells being sufficient for all purposes of ignition, or for conducting electrical experiments in general. Two forms of this battery are shown in Figs. 5 and 6, the one being circular and the other square. Three cells of each kind are only shown, as they are quite sufficient for illustration.

The number of cells required to make up a battery sufficiently powerful for firing a shot will be from fifteen to fifty, according to circumstances.

CIRCULAR CELL BATTERY.

The battery consists of, first, a circular earthenware cell; secondly, a circular iron plate; thirdly, a porous cell; and, fourthly, an amalgamated zinc ingot. These three last named are placed within the earthenware cell in the order above enumerated, and which will be seen more clearly by referring to cell M, Fig. 5. After placing them together, the space between the porous cell and the earthenware cell is filled up to within half an inch of the top with pure nitric acid, while the porous cell is filled up to within half an inch of the top with sulphuric acid diluted with water in the proportion of 1 of acid to 10 of water. The cells are connected together with a piece



of copper wire, care being taken to connect the iron of one cell to the zinc of the next cell, and so on, connecting the iron and zinc alternately throughout, as shown in Fig. 5.

SQUARE CELL BATTERY.

This battery is simpler in arrangement than the previous one, and can be made up more easily and rapidly in this country. The outer cell is of iron, within which is placed the porous cell, and within the porous cell is placed the amalgamated zinc plate. The arrangement is clearly shown in cell O, Fig. 6. The pure nitric acid is poured within the space between the porous cell and iron cell to within half an inch of the top, and the sulphuric acid, diluted with

water, as before, in the proportion of 1 of acid to 10 of water, is poured into the porous cell, filling it up to within half an inch of the top of the cell. The connections are made as before, the iron cell being connected with the zinc plate in the adjoining cell, and so on alternately throughout; great care should be taken to prevent the iron cells from touching each other, and it is necessary in arranging them to put a piece of brown pasteboard or wood between each. Ten of these cells are sufficient to ignite the cartridge, but the actual number to be used depends upon the circumstances and nature of the operations. Twenty cells of this battery have been found sufficient for producing the electrical light.

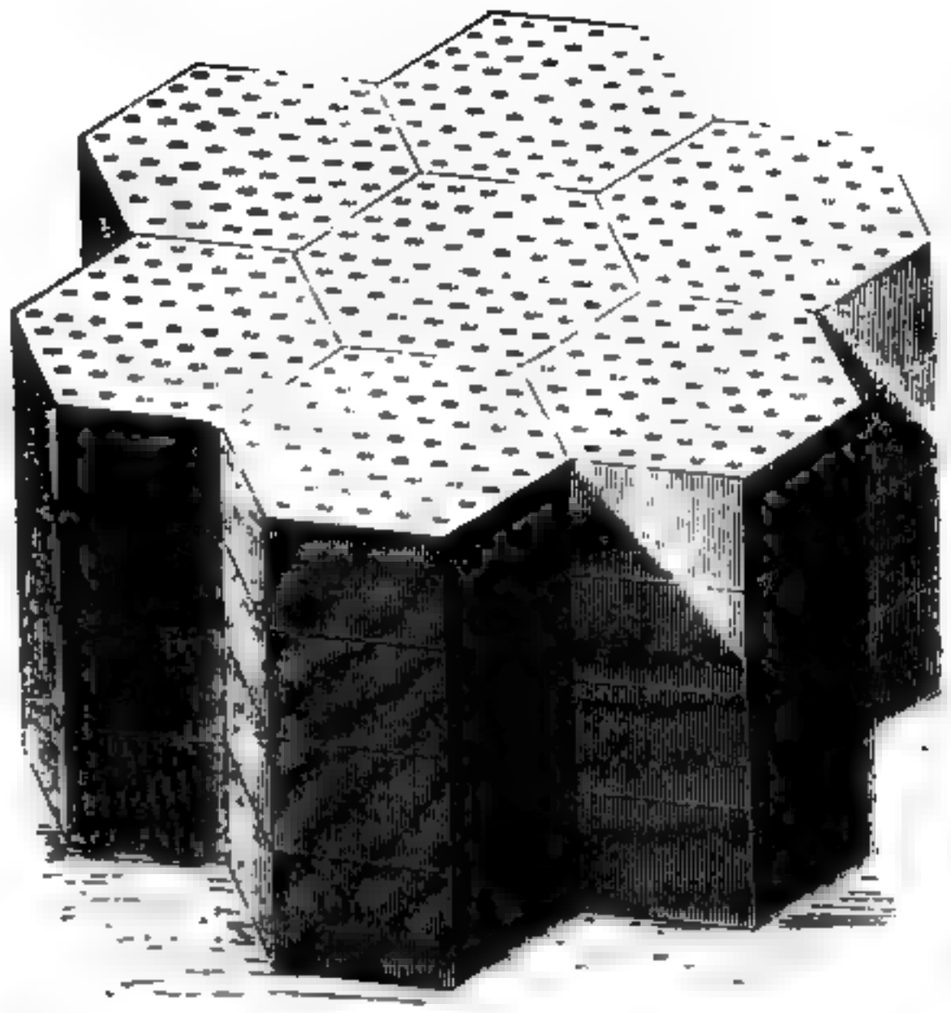
Mines may be sprung at a considerable distance away by the electric battery, as thus described. The Russians had the Malakoff and the Redan Towers all mined underneath, and filled with powder, in order to blow them up if the allies should storm them. They had wires connected with an electric battery at some distance off, but the Malakoff was saved from being blown up when the French entered, for a cannon ball had cut the electric cord, and the mine was thus rendered harmless. Part of the Redan was blown up, but no person was injured, as the English soldiers had been withdrawn almost as soon as they entered, as it was rightly suspected the fort had been mined.

Scientific American—July 27, 1861

RODMAN'S EXPERIMENTS WITH GUNPOWDER.

When ordinary small-grained powder is burned in a cannon, the combustion is so rapid, and the gases are consequently so quickly developed and so highly heated, that an enormous pressure is produced at the breech of the gun before the ball starts from its seat; then, as the gases expand, the pressure is rapidly reduced, so that the velocity of the ball is small in proportion to the maximum pressure exerted upon the gun. It occurred to Capt. T. J. Rodman, of the Ordnance Department, U. S. A., that if the powder were made to burn a little more slowly, the pressure would be less at the breech, and would follow up the ball with more force during its passage out of the gun, thus giving greater velocity to the shot with less danger of bursting the cannon.

The first plan that he tried for producing a slower combustion of the powder was to make it in large grains, which were compressed with great force, so that they could not be permeated by the gas, and, consequently, could burn only by a gradual combustion commencing on the outside and extending inward. Powder of the same quality in every respect, except the size of the grains, was prepared by the Messrs. Dupont, the grains in one sample being all three-tenths of an inch in size, those of another four-tenths, of another five-tenths, and of the last six-tenths. Capt. Rodman made a series of fires with this powder in a 11-inch gun, using the same weight of charge, 12 67-100 lbs., and the same cylindrical shot, weighing 183 8-10 lbs., at every fire. Five fires were made with powder of each size of grain, and the



mean results are exhibited in the following table:

Diameter of Grain.	Velocity of Shot.	Pressure of Gas, in Pounds, At bottom of bore	At 14 in.	At 28 in.
.6	933	21,370	10,350	8,030
.5	932	21,210	11,170	7,300
.4	881	25,590	10,750	7,300
.3	890	35,330	10,710	6,680

The smallest-grained powder, three-tenths of an inch in size, produced a pressure at the bottom of the bore of 35,000 lbs. to the square inch, which was reduced to 6,700 lbs. at 28 inches from the bottom of the bore, giving a velocity to the shot of only 890 feet per second. While the powder of largest grain, six-tenths of an inch in size, though producing a pressure of only 21,000 lbs, at the bottom of bore, followed it up with 8,000 lbs. at 28 inches, and gave a velocity to the shot of 933 feet per second.

The granular form, however, is not the best for cannon powder, whatever the size of the grains. In order to give the greatest possible velocity to the shot, with such degree of pressure as may be safely employed, the pressure against the shot should continue nearly uniform throughout its passage from the gun. It should be exactly uniform were it not for the fact that a less pressure will burst a gun if applied to its whole length than is required to burst it if applied to only a portion of its length; hence the pressure should diminish as the shot recedes from the breech, but not nearly as rapidly, as the experiments show that it does diminish even with the largest-grained powder.

As the shot starts very slowly at the breech, and moves with constantly accelerated velocity in its course through the bore, in order to make the pressure uniform throughout, the gases should be evolved from the burning powder with a corresponding acceleration. But, if the powder is granular, the combustion commences on the surface of the grains and proceeds inward, constantly reducing the size of the grains, and, consequently, the extent of the burning surface. Thus the rapidity with which the gases are

evolved is retarded instead of being accelerated. Capt. Rodman conceived that if the powder was formed into hollow cylinders to be fired wholly from the inside, the burning surface would be enlarged as the combustion progressed, and, consequently, the rapidity with which the gases were evolved would be accelerated. In order to confine the combustion to the interior of the cylinders, he molds them together into a cake, as represented in the cut.

The cakes are submitted to a powerful pressure in a cylinder, the plunger being armed with wires to form the holes. In practice, the axes of the cylindrical holes are parallel to that of the bore. The cakes are made from one to two inches in thickness, the cut representing four of them piled one upon another.

Capt. Rodman says that the increasing rapidity of the evolution of gas may be regulated so as to give any pressure desired along the bore, by establishing the proper relation between the number and diameter of the cylindrical holes, and the thickness of the walls between them.

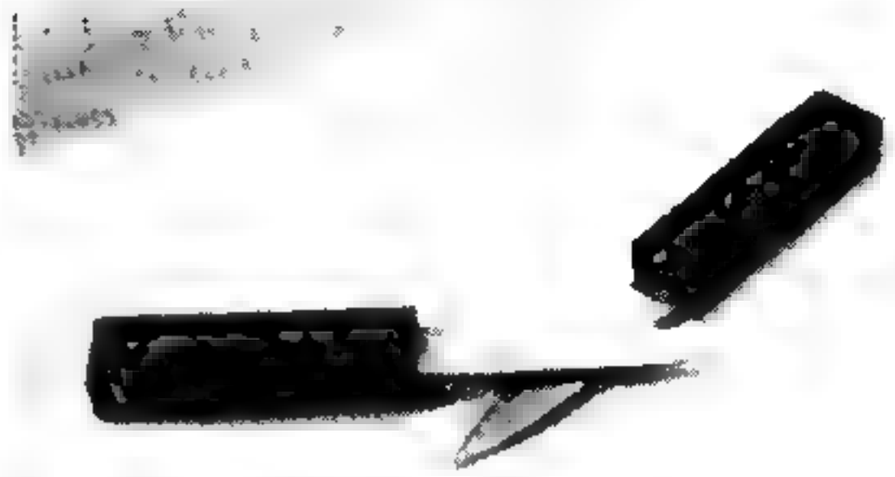
"The initial burning surface, and the ratio of the maximum to the mean pressure, may also be varied by varying the number and thickness of the cakes in a given weight of charge; the initial burning surface, and the maximum pressure both increasing with the number of cakes, since the burning surface extends over the whole surface of the cakes.

"The thickness of walls between the cylinders should be such as to be burned through, or consumed, before the projectile leaves the gun; and for ordinary velocities we should economize in weight of charge, by making the walls of such thickness as to burn through by the time the projectile has traversed two-thirds or three-fourths of the bore, and allowing the gas to act expansively from there to the muzzle.

"It will readily be seen, from the foregoing, that this form of cartridge gives us entire control over the rate of combustion of the charge, a fact the importance of which can hardly be overrated; for, taken in connection with the hollow mode of casting cannon, it removes all limit, as regards safety, to the caliber, of which even cast-iron guns may be made."

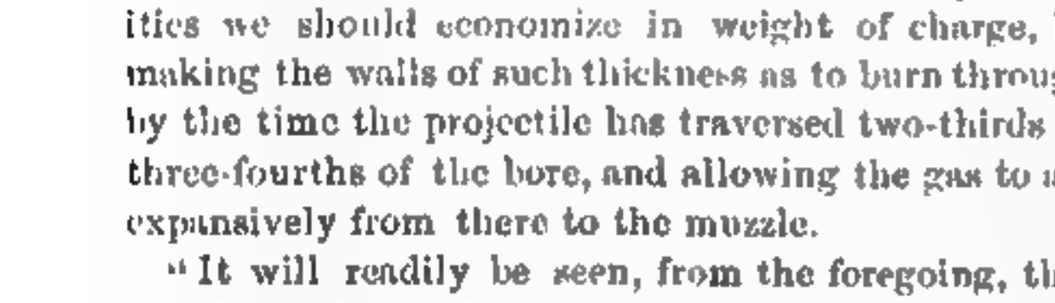
Ozark Bear Claws

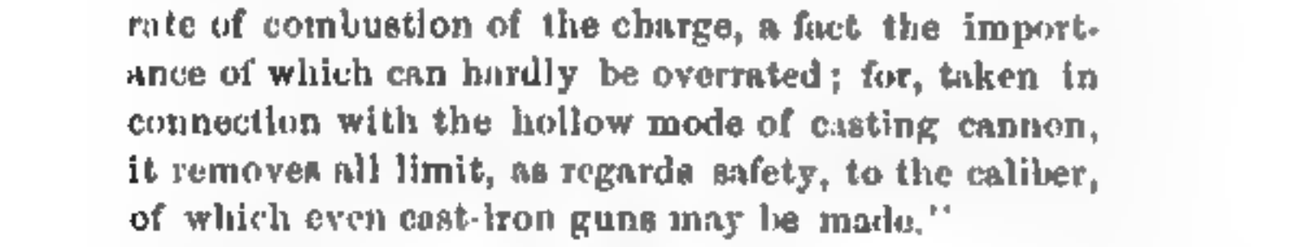
If faced with assault, especially by one with a knife, two knives are always better than one. The Ozark Bear Claws are two knife handles with slits beside the blades to accommodate the blade of each into the handle of the other.



Closed, it just looks like an eight inch long by one inch thick piece of wood. It can be carried in the pocket and can be used as a yawara stick until you feel the need for more drastic measures. Then it becomes two razor-sharp knives held one in each hand and hard to argue with.

The wood components are six four inch long by one inch wide by 1/4 inch thick pieces. Three pieces go for each end. The four outside pieces are hollowed out 1/8th of an inch, leaving 1/4th of an inch of uncut wood around the three sides. One knife blade handle is epoxied into the top half of one and the bottom half of the other. then all the pieces are epoxied to make an unbreakable bond. Care must be used to hollow out the blade holding sections so they fit snugly. This is so they will hold together until purposely pulled apart.





Scientific American—Sept 7, 1861

A NEW MODE OF CONSTRUCTING CANNON.

BY J. C. BABCOCK, C. E., CHICAGO, ILL.

Notwithstanding the very satisfactory accomplishments of modern artillery, there yet remains a great opportunity for improvement in its efficiency. This branch of military science should receive a greater share of the attention of our scientific men, for if cannon are to be constructed doubly efficient to any now in use, we cannot, without imminent danger, shut our eyes to the fact.

Better field pieces are wanted, combining greater strength and lightness. Before any degree of perfection in both these requirements can be obtained, the following problem must be solved:—What method of construction will occasion the most equal distribution of the circumferential strain, throughout the

mass of metal ?

No known material is capable of receiving a tensile strain without stretching. Cannon are subjected to two indirect tensile strains, circumferential and longitudinal. Now it has long been known (but not generally understood) that increasing the thickness of metal in a gun does not increase its circumferential strength beyond a certain point. This fact is easily proved and explained by the following experiment:— If we make equi-distant concentric lines on the end of a hollow cylinder of soft brass, Fig. 1, and impart an equal circumferential strain by means of a circular wedge driven into the bore, Fig. 2, we can at once observe how much more the inside is stretched than the outside, or even the intermediate spaces. The spaces between the lines will be seen to vary in width in direct proportion to the amount of strain on each, showing that while the inside space is strained almost to breaking, the intermediate spaces are much less strained, and the outer scarcely any at all.

Fig. 1

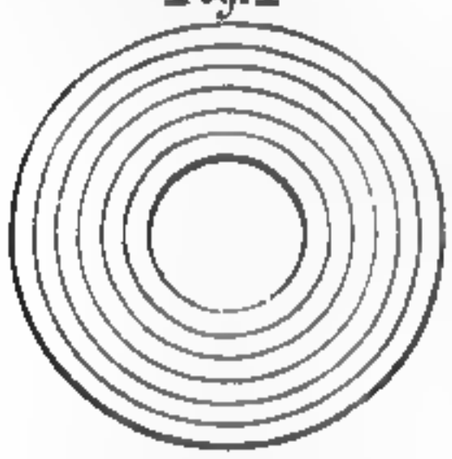
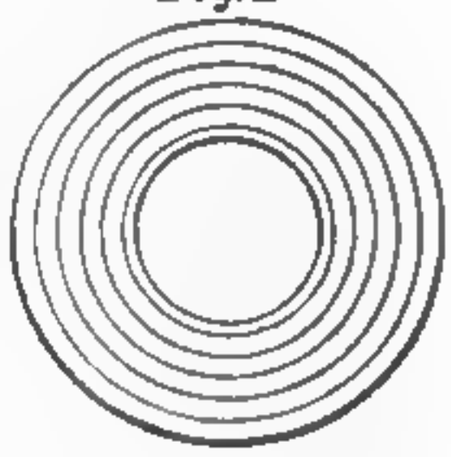
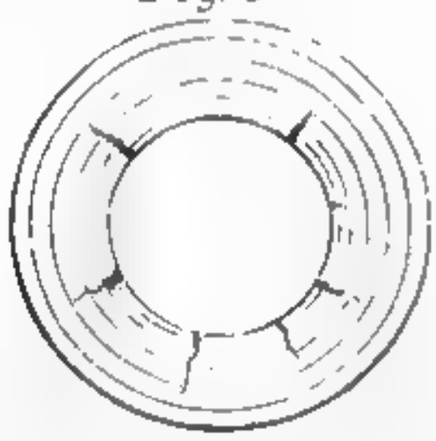


Fig. 2



Now if we increase the strain sufficiently to produce fracture, by driving the wedge still deeper, Fig. 3, it will be observed that the inner spaces will be completely severed, while the outer remains comparatively sound.

Fig. 3



The law has been found that in cylinders of metal, the circumferential strain on the different parts varies inversely as the squares of the distances of the parts from the axis. According to this ratio a two-inch gun with two inches of metal, will be internally fractured before the exterior receives one-twelfth part of the strain causing the fracture. Of course increasing the thickness still more would add very little to its strength.

The longitudinal strength has a direct bearing on the circumferential. The metal undergoing the opposite strains of compression and extension at the same time, is weakened in the former capacity in proportion to the strain in the latter, therefore increasing the longitudinal strength by adding thickness to the gun, increases its circumferential strength, but it is only to a certain degree.

Longitudinal strain being uniform does not affect our ratio of the circumferential strain. Ordinary guns have a longitudinal strength twelve times greater than their circumferential, while the strain in the latter direction is eight times as great as in the former.

I think no better disposition of a solid mass of metal will ever be made than in the scientific proportions of the Dahlgren guns; yet what a pity to have so much of the material comparatively idle.

How then are we to equalize this immense circumferential strain which possesses the same ratio of inequality in all solid masses of metal ?

A scientific arrangement of the material should be made whereby the several parts would take a moderate share of the strain, instead of the interior parts having too much and the exterior too little.

Numerous plans have been tried to accomplish the object, yet none have succeeded better than Armstrong or Whitworth. The wonderful accuracy and range of their guns is owing to the great velocity given to the shot which thei method of construction alone renders possible. Their respective plans, although alike in principle, differ somewhat in execution. Their guns are built with concentric tubes or rings shrunk successively on each other with a gradual tension. The tension is increased from the interior to the exterior of the gun by a greater expansion in the heating of the different parts.

Another plan has been attempted to accomplish the same object by winding wire around a cylinder, increasing the tension each layer. Were there no longitudinal strain to contend against this plan would approach perfection ; but it being necessary to braze the wire together in order to give the gun sufficient longitudinal strength, the heat required in the operation destroys the tension, rendering the gun at once inferior to one wrought in a solid mass.

Fig. 4

As has been said before, the longitudinal strain weakens the circumferential strength ; this is a fact pertaining to all cannon that have yet been constructed. The idea has occurred to me, that in such a predominance of the longitudinal strength compared with the strain, that such an arrangement of material might be made whereby the longitudinal strain would assist, instead of weakening the circumferential strength. My plan for accomplishing so seeming an impossibility is as follows :--

On a cylinder of cast iron (the best material for the inside of a cannon) shrink a layer of wrought iron rings with moderate tension ; these, with the cylinder should form about one-half of the thickness of the gun, Fig. 4. Bands of steel should now be wound spirally in alternate layers to the required thickness, reversing the winding each layer, Fig. 5. These bands should be wound while heated directly from a furnace prepared for the purpose, and the tension in-

creased on each layer in proportion to its distance from the bore, by regulating the heat.

Fig. 5

I am inclined to believe that this method of construction will make a stronger gun than has yet been produced. The longitudinal strain on the spiral windings, increases the tension at the moment of discharge when and where it is most needed, for no spiral can be extended longitudinally without diminishing in diameter. The arrangement of the materials in the order of their expansive properties, gives more work to the exterior of the gun, for cast iron is doubly more expansive than wrought iron, and wrought iron even doubly more expansive than steel.

The proper proportionment of the different materials in such a construction can only be obtained by experiment; when found, a gun must be made of immense strength and comparatively light.

An increase of strength in a cannon is an increase of its power and efficiency as an engine of war, especially when lightness is also combined. Modern ingenuity is advancing the perfection of the powder, bore and projectiles far more rapidly than the gun itself will permit of, and when cannon are made stronger and more scientifically, it will be time to turn our attention to the minor considerations of projectiles and breech-loading.

CYANIDE GRENADES

By KURT SAXON

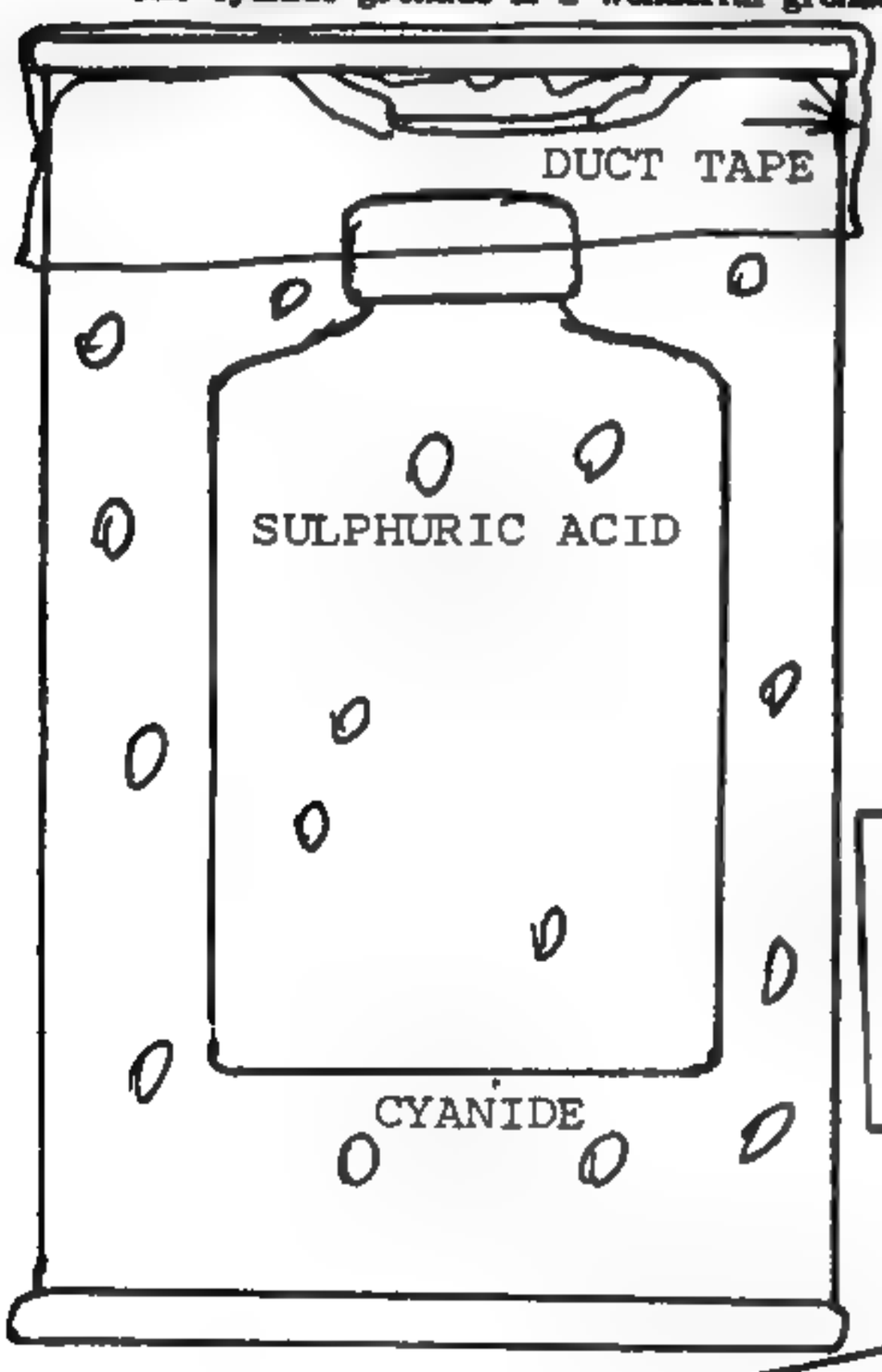
The cyanide grenade is a wonderful grenade. It is much better than the fragmentation grenade as it is not noisy. Nor does it destroy property or cause closed casket funerals.

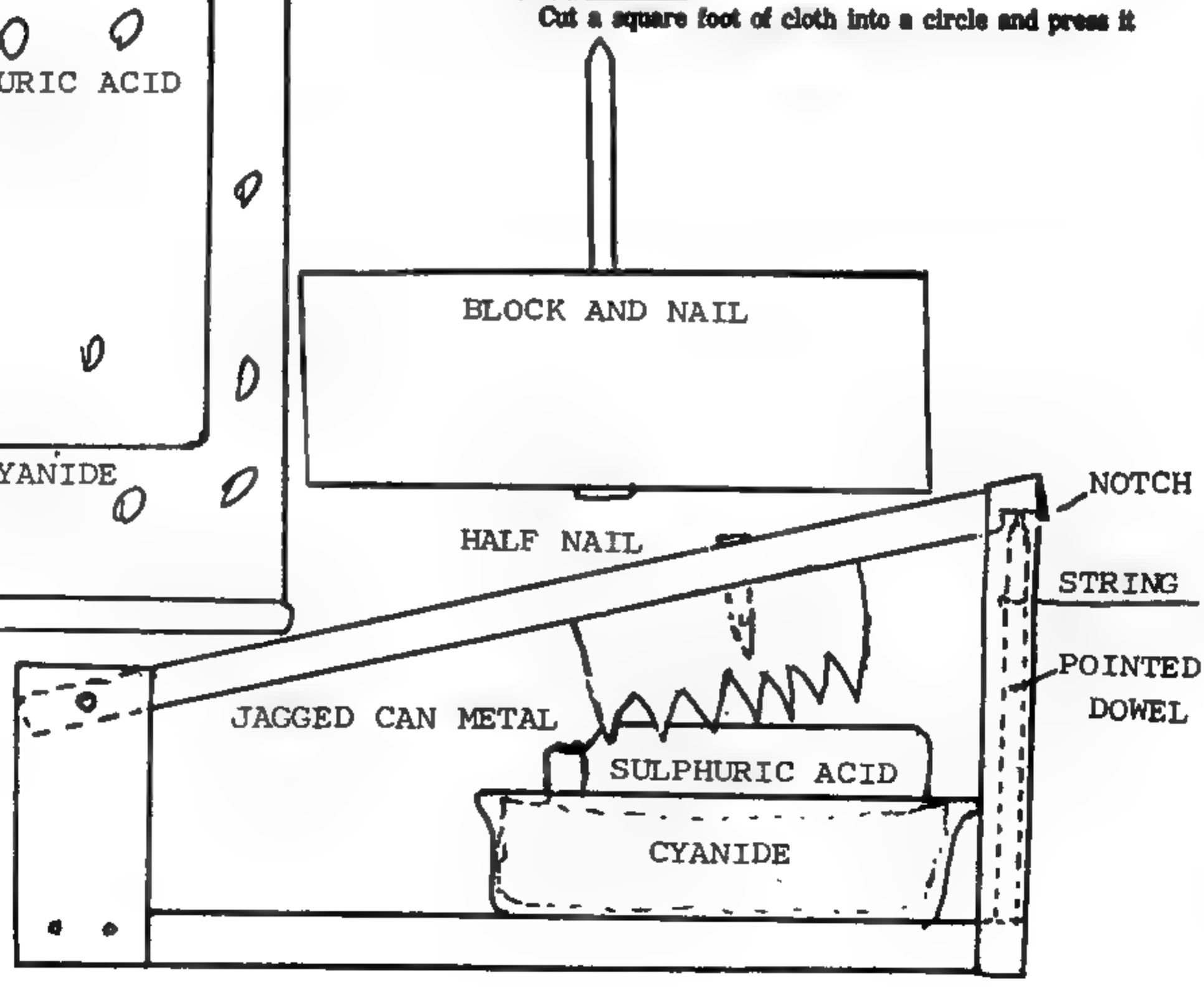
A modification of it is an excellent protector for the home when you are away. For cleaning out fag bars or enemy emplacements you can find no better weapon. It is easily made and costs next to nothing.

The materials are a 15 ounce tin can, with lid, one square foot of cotton cloth, duct tape, a four ounce glass bottle with a sturdy plastic top, sulphuric acid and cyanide. The igniter is a palmsized, one inch thick block of wood with a sturdy nail through it.

First, punch a dozen holes in the can with a sharp nail and a hammer.

Cut a square foot of cloth into a circle and press it





around the inside of the can with its edges protruding.

Put about an inch of cyanide into the can and put the bottle of sulphuric acid in the exact middle. Fill the can around and above the bottle with more cyanide.

Gather the cloth and tie it tightly with string or wire. Put on the can's lid and seal the grenade on top and around the top side with duct tape.

Cyanide attracts moisture so the grenade should be stored and carried in a sturdy plastic zip lock storage bag.

To use, remove from the bag and insert the nail into one of the holes near the middle of the bottle. Give the block a sharp smack with your palm to break the bottle and then toss it into the tomb of your choice.

To booby trap your home is easy. All you need is some wood, sulphuric acid, cyanide, dowel, inner tube rubber band and a plastic butter dish.

For the base, use a one foot long by one inch thick by three inches wide piece of wood. At one end, nail on two pieces of wood which have been drilled to hold a thin dowel. Drill a similar sized hole through the side of one end of another one foot strip of wood. Saw a piece out of the other end to form a notch.

Cut a large nail in half, sharpen it and bang it into the middle of the board about one-third of the way from the notched end.

Cut up a tin can and bend it so there is about an inch on one side of the bend and three inches on the other. Cut two three inch strips of this and cut a deep saw edge on each. Glue or tape the jagged strips about three inches apart on opposite sides of the nail.

Put a strong rubber band cut from an inner tube around the ends of both boards. Stretch it tightly and prop it up with a dowel pointed at the top end. Tie a string to the dowel and stretch it to a door knob or across a corridor or hall where an intruder would be bound to walk into it.

Before leaving your home or office, put a plastic butter dish or like container under the nail. Put a plastic bag with several ounces of cyanide in the dish. Next, put a four ounce bottle of sulphuric acid on the cyanide under the nail.

When an intruder comes in contact with the string, the dowel will be pulled out and the board will slam down. The nail will break the bottle and the jagged tin will shred the plastic bag. The acid will flood the cyanide and in seconds the area will be filled with deadly gas.

The gas dissipates in a couple of hours. Ideally, you should place the trap so you can at least see the taut string when you open the door. If it isn't taut you should hold your breath and go in and open some windows and get out before breathing. At the same time, turn on a fan or air conditioner if you have one.

Shut the door and return in a couple of hours. By then, it should be safe, even if it happened only shortly before you returned.

Go back in and examine the body. Take any money or valuables for your trouble. Dismantle and hide the trap. Open and rummage through some drawers to make the place look like a burglary was in progress.

Call the police and tell them a burglar got in and died of a heart attack or something. There is little chance a thorough autopsy would be conducted and even so, you were out and he had no business there and what could they prove? If it is night and there are no witnesses outside you can dump the vermin in the nearest alley and forget it.

Scientific American—Sept. 1861

What Guns Are Best.

It is no doubt the desire of every army and nation to possess the best implements of war, but great uncertainty prevails as to which are the most efficient. The principles of operation and the principles of mechanical construction embraced in the variety of weapons now brought before the public, are so different, and the opinions are so numerous respecting their merits, that it is very difficult to arrive at proper conclusions respecting them. A few words on this subject, to bring the matter intelligently before those in authority and the public, may be of some service.

Rifled cannon are now held to be the most efficient for artillery purposes. Their aim is more accurate and their range much greater than the old smooth-bored cannon, hence they are most destructive. It now seems to be the object of military authorities everywhere to bring them into general use, and if one army is provided with rifled cannon, its adversary must obtain similar guns or fight at a great disadvantage. For close engagements smooth-bored cannon must always be employed for firing grape and canister ; therefore, although rifled cannon are the most effective at long ranges, smooth-bored guns must form a large portion of the effective artillery belonging to an army for action at close quarters.

There are two special classes of rifled cannon, respecting which there are divided opinions among military men and others. The one has a movable breech and is loaded at the rear ; the other has a close cylinder behind, and is loaded at the muzzle. It is claimed for the breech-loaders that they can be loaded with less labor, are more convenient for receiving shot and shells, and that expanding shot are not required for them. The objections to them are, that they are more complicated and expensive in construction than muzzle-loaders, and they are more liable to get injured and become inoperative in action.

The greater simplicity of muzzle-loading cannon is admitted, but either winged shot or expanding shot is required for them. If muzzle-loading rifled cannon are equally as good as breech-loaders, all the sound old smooth-bored guns in our arsenals, forts and navy yards can be converted into serviceable and efficient rifled guns by simply grooving their insides, and this can be effected at a very small expense. This is, therefore, the important subject for consideration, as it now divides the opinions of very able military authorities.

The English and the Prussian governments have given their countenance to the adoption of breech-loading rifled cannon, and the Belgian government has recently proposed to expend about $3,000,000 for the re-construction of its artillery, adopting the Prussian screw-breech guns, which are said to be less dangerous in loading, more accurate in aim, and easier loaded than those which are charged at the muzzle. On the other hand, the French, Russian, Dutch and

Swedish governments have adopted muzzle-loading rifled cannon, the Hollanders having converted a number of their old worn-out pieces into good rifled guns by a process which exhibits genuine economy and considerable ingenuity. In the arsenals of Ho land there were a number of six-pounder bronze gur which had become so defective by use that they were condemned to be re-melted and re-cast. A happy thought struck one of the engineers. He proposed to clean out the bores and partially fill them in with a re-casting of bronze metal and then rifle them. This suggestion was carried out, and the old six-pounder defective smooth-bored cannon have been converted into rifled guns. By this simple process the Dutch have obtained from their old condemned bronze guns as efficient light field pieces as those of France and Russia, at the expense of only seven dollars for each.

Those who have advocated the muzzle-loaders and condemned those which are charged at the rear, say that the latter have been tried and condemned long ago—that they were the earliest class of guns made, therefore they should not receive that attention which is now bestowed upon them. Such a charge as this should receive but little consideration, for revolving firearms were really among the most early that were tried, and in the Tower of London there is a firearm nearly two hundred years old, which has a revolving charge chamber operated on the same principle as the most approved modern revolvers; and yet such weapons became lost to the public until revived by the improved Colt pistol.

Every firearm should be judged upon a consideration of its own merits, after repeated trials, and not by the prejudices and interests of any man or party. This is the only way to arrive at right conclusions respecting the merits of any piece of mechanism.

Having paid considerable attention to various kinds of guns, we believe that every sound gun in our country may be converted, at a trifling expense, into a good and efficient rifled cannon by the simple operation of rifling. We consider it folly to expend large sums in obtaining new rifled cannon while old ones can be rendered nearly as good as the best that are made from new materials.

The public has read accounts of the Sawyer, and James and the Hotchkiss cannon, but the guns which have received such names are common rifled cannon. The names of the inventors of the peculiar shot which were fired with rifled cannon, have been transferred to the guns by correspondents of papers unacquainted with the inventions.

In the construction of new rifled cannon for loading at the muzzle, we believe it will be found advantageous to employ a screw-breech piece, to remain fixed in firing, but which, if a shot should get fast in loading, may be removed for the purpose of getting out the charge easily. This method of making muzzle-loading cannon would be an improvement, we believe, and the same principles of construction may also be applied with advantage to small arms.

THE GAROTTE

By GENTLE BEN

The garotte has been made obsolete by weapons such as the silenced pistol. It's one advantage is that, with luck, you'll leave no blood behind. But your opponent will often defecate. However, sometimes you have to make do with what you have. And it is the macho assassination method. Mafia types are still terrified by that sort of hit. Practice it with a friend, in slow motion, a few times. You'll get very good at it if you have the mentality.

One of the best garottes you can have is a leather bootlace. Wrap the ends around your hands, holding the ends in your palms. Always approach your opponent from behind, preferably unaware. Try to always pick on someone weaker than yourself.

Either loop the lace over his head, or loop it before you place it over his head, whichever is quickest and easiest. That will depend on you and the type of garotte you use. Pull down and slightly to the side to tighten the garotte. Yank as hard as you can. Try to break his neck. Although you probably won't kill him by breaking his neck, even a minor dislocation will weaken him so he can't fight back effectively.

Of course, if the idea is to capture the victim alive, be a little gentler. As you pull the garotte, bend down on your knees, dragging him down on his rear. Be sure your knees are completely bent, to protect yourself from back elbow strikes. Your balance is better if you sit on the heel of one foot and keep the other foot flat.

You are now in a tight, guarded position and he is in an awkward one. Keep the pressure on and hang on like a bulldog. There are many things he can do to you at this point. But if you are tough enough, they shouldn't be too effective.

The garotte doesn't kill by strangulation. It cuts off the flow of blood to his brain. In about five seconds he should be noticably weaker. In about ten seconds he should be unconscious or in a helpless, semi-conscious state. As anyone who has been the victim of a sleeper hold can tell you, it is a painless death.

Another style is the tall man method. This should be used only on people your height or taller. It gives you a much better chance of breaking his neck. Its disadvantages are: you leave yourself vulnerable to back elbow strikes; you turn your back on your opponent, and there is an effective counter, which I'll explain further along.

You hold the garotte in the same manner as before. However, you don't loop the garotte over your opponent's head. Once you place it over his head, you turn around. This automatically twists the garotte. You then bend over and jerk the garotte as hard as you can.

If you are attacked in the tall man manner, try a back elbow strike, before he tries to jerk your head off. Get a hand between your throat and the lace. If you fail in that, or fail to react in time, roll with his force and do a backward somersault over him (not as hard as you might think, considering you have his back to do it on). With any luck, your neck won't get kinked up enough to keep you from fighting back. Anyway, you'll be pretty well off for someone dumb, trusting or naive enough to allow a deadly enemy to get so close, unnoticed.

The piano wire garotte has the advantage in that it is less likely to be seen going over your opponent's head, and it tends to cut his hands if he tries to interfere. Its disadvantages are that it tends to leave blood behind, and

if poorly made, it tends to snarl (at the wrong time it can be quite embarrassing).

To my knowledge, the stories of cutting a man's head off with it are a bunch of bull. The man who taught me most of what I know of garottes tried three different times and failed to take the head off He was a resistance fighter in Rumania during WW II. Now a Green Beret. Contrary to the war stories you've heard, he was one of the few military men ever to use the garotte. He was fairly strong. If your intentions are to cut your opponent's throat, I suggest you use a knife.

A sturdy snake catcher, such as one made out of pipe with the twine running inside, is a very good garotte. Be sure to pull your opponent backwards and move him to keep him from turning around. Very difficult to break his neck with this garotte.

The sleeper hold is a way to garotte without a garotte. Place one wrist on your opponent's throat, one on the back of his neck Lock your hands on your elbows and squeeze. Pull him down in the basic garotte style.

READY KILL-A-WATT

By "THE MAD DUTCHMAN & DOC ROSCOE"

If you've ever been shocked, you know how dangerous electricity can be. Most of us assume, when considering the lethality of electricity, that higher voltages are deadlier. 'Taint necessarily so! What kills is current (amps), not voltage. As you can see from figure 1, the

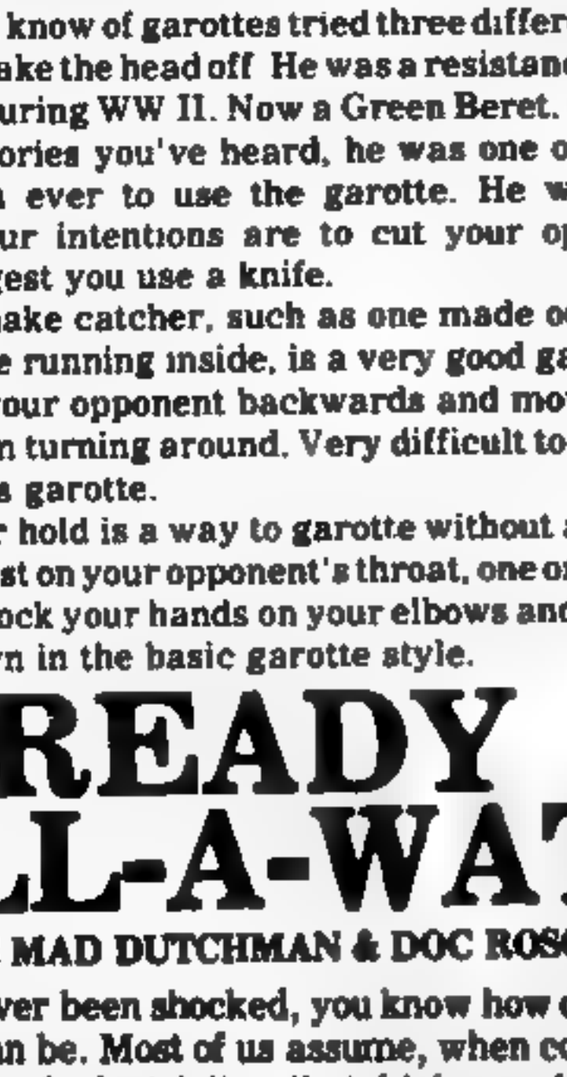


Fig. 1 Effects of electric current

lethal range is between 0.1 and 0.2 amps. To deliver this dose, a voltage from 50 to 10,000 volts is necessary. Factors that influence the voltage required are the resistance of the victim's skin, which can range from 1000 to 50,000 ohms; the weight of the victim; where the current is applied; and the person's biological resistance to shock (weak heart, etc.)

The current delivered is derived from the formula:

amps = volts / resistance

To be most effective, the voltage should be applied so it will be across the heart; for example, from one arm to the other. Remember, it doesn't help if the victim touches a high voltage source while insulated from the ground by rubber sole shoes or similar protective gear. Take these considerations into account when planning your defense system.

The best voltage to use is approximately 600 volts. Happily, this can be obtained from an old TV transformers' high voltage taps. (Most late model sets don't have them, so find an oldie.) If you don't know what a TV transformer looks like, get one from a friendly neighborhood TV repairman. (Most repairmen have LOTS of old sets, and will be glad to sell you a transformer.) Once you have a transformer, you will notice many wires sticking from it. One set is to be connected to wall current (110 vac). One of the other pairs is the high voltage set. To find the right pair, ask the repairman or a friend who knows about electronics. Their location is a trial and error process which requires a VOM and a low voltage AC source. This can be deadly if you don't know what you're doing.

If you don't want to fool with a transformer, you can use 220 or even 110 AC wall current. Many medium-sized portable gas generators put out 220 as well as 110. 220 is normally used in dryers and ranges. Its plug is about twice the size of anormal wall socket, and resembles figure 2.

Fig. 2 Typical 220 outlet

Once you have procured your voltage source, you must implement it in such a way that the victim is in extended and intimate contact with it, while at the same time not allowing the voltage source to be shorted out to ground. There also must be some provision of a fuse or circuit breaker so that once the victim is electrocuted, the current will not flow until the generator burns-out or the wiring overheats. If you ever have to attack a place protected by electric fences, you can defeat them by using a piece of metal to ground out the fence. Just don't electrocute yourself in the process. This technique will also probably alert any defenders.

Some suggestions on applications; soup-up a cattle fence. Electric fences are best against a sneak, night attack. Supplies for building an electric fence can be obtained from the Sears Farm Catalog. Another idea is to replace your doormat with a piece of heavy wire mesh and wire the other side of the voltage source to the doorknob. (Gets rid of bothersome salesmen, too!) Any sort of metal fitting, railings, etc. can be wired as long as it is properly insulated from ground. The ultimate would be a ladder with metal rails (wired to the power source) and wooden rungs. Even a car can be wired up similarly. Almost any metal fitting can become a deathtrap. Good luck!

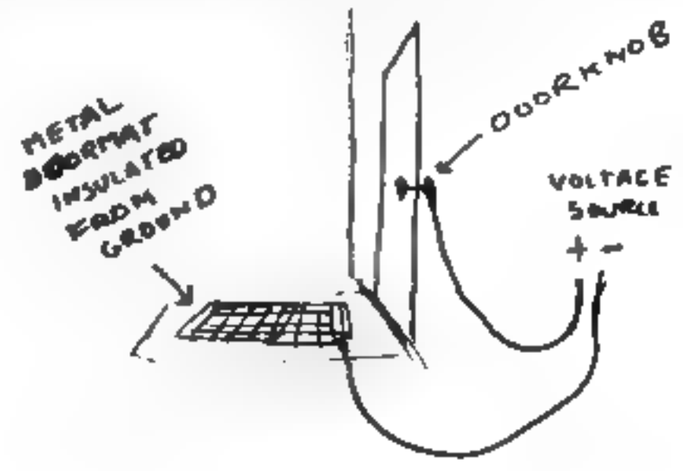


Fig. 3 Doormat Surprise

Army Type Air Pistol Easy to Build

THE MECHANICAL PACKAGE MAGAZINE 1931

SERIOUSLY surprising are the shooting qualities of this home-designed, home-made air pistol.

The idea for the gun came to Slide Rule Sam through a piece of mail addressed to him, and in turning it over to the editors, we quote the note he attached to the script: "It works. When I saw the idea and the sketch Eugene Amstus forwarded the Station the other day, I said it ought to make a good bunny-buster for that big jackrabbit that inhabits the neighboring Bar-Circle Bar-Circle Bar-Circle Bar-Circle cabbage patch. He's been thumping around under the Exp. Sta. shack a lot these winter nights, and I aimed to get him. We built this little gun according to Amstus' sketch and yesterday had rabbit stew. The thing is simple—just brass tubing thrown together with a soldering iron as the sketch shows. Run it. Great fun!"

As may be seen the barrel is of ½" outside diameter brass. A 3/16" bolt clamps in through a babbit seat in the breech for ramming out refractory shot when jammed.

The BB tube will have to be hand picked, and ought to be hard brass, just big enough to swallow a BB without trouble or friction. You'll have to adjust this to the shot you are using, as BB shot is never definitely standard.

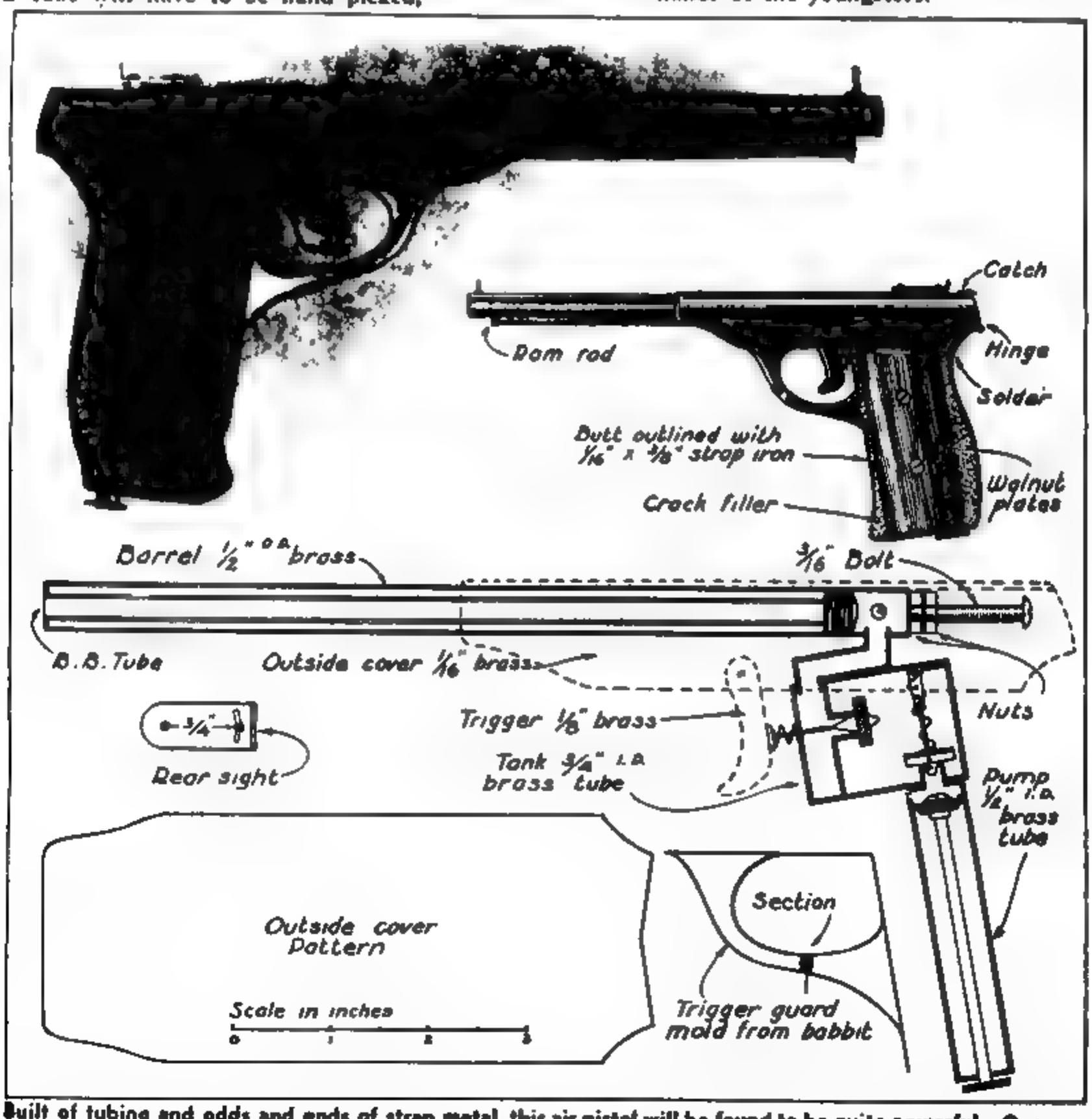
The pump barrel and the tank or concussion reservoir for storing air, are of brass tube. Use stiff springs for the valves, and cover them with oily leather, pounding them to a seat.

Outside cover pattern and trigger frame are of sheet metal. The stock is of walnut screwed to an outlined butt made of ⅜" by 1/16" strap iron.

A BB is rammed down, eight or ten good strokes taken, and the gun can then be shot. Muzzle velocity is controlled by the number of pump strokes.

Shoot at a pine board to test the pistol. If a BB sticks in this board at 25 feet you have plenty of power for target shooting and for bringing down small game like Slide Rule's jackrabbit.

This will be found a practical and useful little weapon if carefully made. A relief valve can be fitted limiting its power for use in the hands of the youngsters.



Built of tubing and odds and ends of strap metal, this air pistol will be found to be quite powerful. One was actually built at the Packmag Experiment Station as pictured and gave good results. Gun is muzzle loading.

THE MECHANICAL PACKAGE MAGAZINE 1932

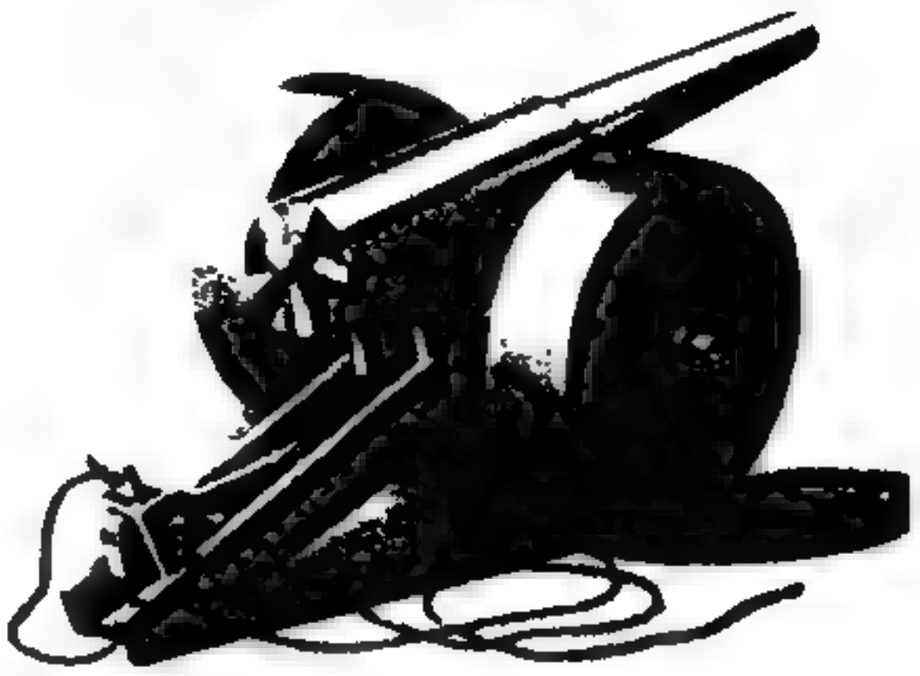
A MODEL Brass CANNON

Shoots .22 Caliber Cartridges

CLAUDE J. SISK of Washington, D. C., writes about a small cannon he has made out of brass and cold rolled stock, and which shoots .22 caliber cartridges, either blank or loaded.

Briefly his description runs like this: The gun can be made in any work shop which has a small lathe. The barrel is of round brass stock, and is ¾" in diameter at the breech and 7/16" diameter at the muzzle. The barrel is bored on the lathe with a No. 2 drill. The barrel is milled out, as shown in the drawing below, for the side clamps on the bottom.

The wheels are of wood, turned on the lathe. If close-grained hardwood cannot be had, use red fiber, altho hardwood is preferable.



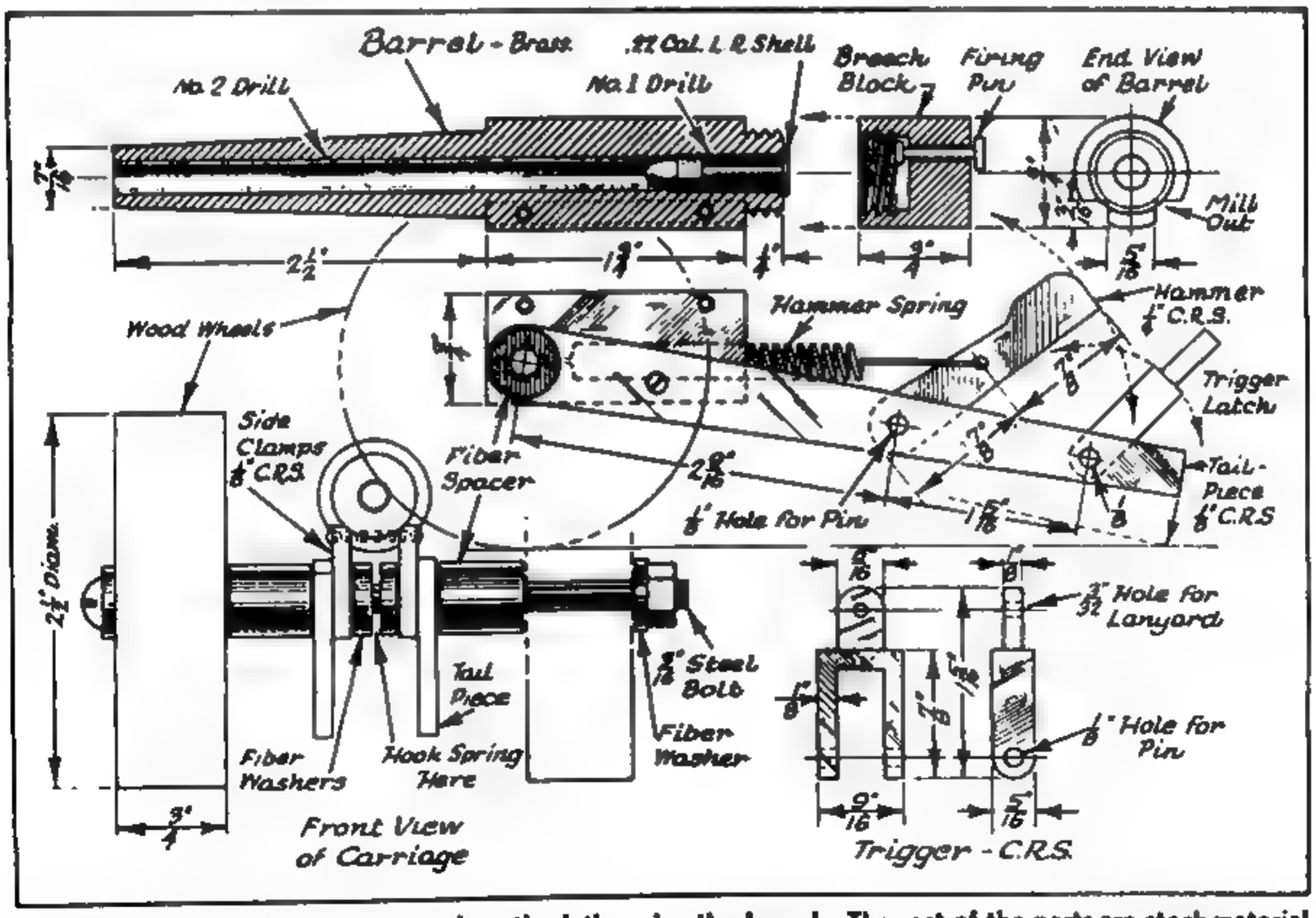
Here is an isometric of Claude Sisk's little gun.

Side clamps and tail piece are ⅛" cold rolled steel. Hammer is ¼" c. r. s.

The materials list: 1 pc. ¾"x6" round brass; 2 pcs. ⅛"x¼"x4¾" c. r. s.; 2 wood or fiber wheels; 2 pcs. ⅛"x¼"x1¾" c. r. s.; 4 spigot washers ½"; 1 pc. ⅛"x5/16"x4" c. r. s.; 1 pc. ⅛"x½"x1¾" c. r. s.; 1 length ⅜" screen door spring 2".

You will also need 1 pc. ⅛" round c. r. s. for rivets and the axle.

The fiber washers are to separate the frame and the fiber spacers on the axle. The trigger and the hammer can easily be worked out with a hack-saw, a drill press and a file.



The barrel and the wheels are turned on the lathe, also the breech. The rest of the parts are stock material. Note the breech with firing pin which is hammered by a cold rolled steel hammer. The trigger is pulled by a breech cord and can be made out of cold rolled stock by sawing with a hack-saw and then filing.

Harrassment as a Weapon

THE WEAPONEER is crammed with all sorts of goodies that will exterminate your enemies, but sometimes you don't want to kill or injure someone. You may want revenge for problems that don't justify violence, for being cheated, or for being harrassed yourself. This is the time for harrassment. There is also virtually no chance of being caught, because the overloaded police will not give serious attention to anyone complaining of unwanted pizzas being delivered. On the other hand, an explosion or corpse just might cause them to take notice. The following are a few simple ideas that have worked. They will really drive your victim nuts.

1) KEEP QUIET!! This is most important. Don't tell anyone who doesn't need to know about your project. Your victim can hear through the grapevine. You don't know who your drinking buddy might tell. Don't threaten your victim. Let him wait to forget about you. Use this time to learn his name, address, phone number, job, etc.

2) Send in magazine and book club subscription cards in his name. Order things C.O.D. for him over the phone. Sexually oriented publications are good, because they can cause a stir within his family and neighborhood. This will keep him busy with unwanted bills and merchandise.

3) Use the telephone. Read the Yellow Pages. Look for ads that say "We Deliver". Send him every conceivable product and service. These range from the obvious (pizzas, plumbers), to the bizzare (diaper services, gravel, manure). You can also send him salesmen, estimators, real estate agents and repairmen by telephone.

4) Sell everything he owns. Do this by placing classified ads in the paper in his name for his house, car, boat, and furniture even if he doesn't own any. This will keep his phone tied up constantly. You can also have him offer to buy old tires, aluminum cans etc. The cost of the classified ad can be billed to his phone bill.

5) Among the things that can be billed to his phone bill are flowers by wire, candygrams, and insulting telegrams signed in his name. All of these can be done over the phone, with no personal contact whatsoever.

6) Arrange over the phone to have his utilities shut off. You can also file a change of address card with the post office to divert his mail.

7) Most of the techniques outlined

WONDER COMPOUND FOR WARRIORS

by Kurt Saxon

No matter how well-armed you are, if your mind isn't calm, your judgement will be distorted. Being upset during a confrontation will give your opponent the edge every time.

Worse, in times of personal crisis or social upheaval your judgement may be so distorted that you may suspect friends of being foes. So you should have a good supply of the wonder compound I formulated to keep your mind alert and your ideas in perspective

You can get the herbs described further on at any health food store and make up the compound yourself. You can also buy it in bulk quite cheaply.

I'm not a snake-oil salesman and since I won't be selling you this compound, you can be sure it acts exactly as I say it does. It has been well tested on many people, especially roughnecks and it doesn't turn a lion into a pussy cat. It just makes him a lion who knows who to spring at, and when.

Its main effect is to relieve stress. When you are angry, frightened, up against a situation you feel threatened by, your body releases adrenalin. This is Nature's preparation for fight or flight. If you can do either; if the situation plainly calls for one or the other, little stress is involved. But if you are frustrated; if either fighting or running away would be irrational, you freeze in confusion and helplessness. You spin your wheels and the adrenalin flows into your system, wasting itself in stress. You do nothing, as distorted impressions of reality flood in, making you feel only more helpless and insecure or angry.

Coincidentally, as I was taking a break from writing this passage, I was rereading George Orwell's "1984". The part I happened to be reading was from page 101. "It was at night they came for you, always at night. The proper thing was to kill yourself before they got you. Undoubtedly some people did so. Many of the disappearances were actually suicides. But it needed desperate courage to kill yourself in a world where firearms, or any quick and certain poison, were completely unprocurable. He thought with a kind of astonishment of the biological uselessness of pain and fear, the treachery of the human body which always freezes into inertia at exactly the moment when a special effort is needed. He might have silenced the dark-haired girl if only he had acted quickly enough; but precisely because of the extremity of his danger he had lost the power to act. It struck him that in moments of crisis one is never fighting against an external enemy but always against one's own body. Even now, in spite of the gin, the dull ache in his belly made consecutive thought impossible. And it is the same, he perceived, in all seemingly heroic or tragic situations. On the battlefield, in the torture chamber, on a sinking ship, the issues that you are fighting for are always forgotten, because the body swells up until it fills the universe, and even when you are not paralyzed by fright or screaming with pain, life is a moment-to-moment struggle against hunger or cold or sleeplessness, against a sour stomach or aching tooth."

Such deactivating stress builds up, not only in times of real crisis, but in situations of quiet desperation such as a dead-end job, an unhappy marriage, noisy youngsters, endless school work, debts, etc. One wants to strike out and smash or just run away. But honor or the law forbids, so one's world closes in and even real solutions are hidden because the adrenalin demands immediate action, which is impossible to one who has responsibilities.

The reason for such stress in homo sapiens is the conflict between the upper and lower brains. The lower brain is that of an animal, with the same drives and desires for quick action towards gratification as that of any dog. A dog will fight or run, mate, eat, defecate, as the situation presents itself with little apparent inhibition. He has no upper brain with its intricate programming of rules, regulations, choices, responsibilities or taboos and the endless dos and don'ts which makes the human stand and take it and be glad and prosper.

So when the lower brain makes its demands, the upper brain curbs the instinct for instant gratification and/or solutions. You must not smash the boss's head, injure the noisy child, clobber the whining wife, quit school, go AWOL, default on your debts, and so on. But all too often, the highest human types take on too many challenges and responsibilities. This is what causes such stress in superior men. So stress builds up so often and so long that even the best of men can refuse to go that extra mile or even yard.

What my compound does is suppress the irrational impulses of the lower brain. That's what tranquilizers such as Valium, Thorazine, and Librium do. But they also suppress the working of the upper brain, causing dullness and disinterest, almost like a lobotomy. They also dull the reflexes. Furthermore, after a few months on tranquilizers, the user becomes addicted and stopping brings on the same withdrawal symptoms as stopping heroin.

My compound not only quiets the illogical demands of the animal brain but has no effect on the upper brain. For instance, I found I could score better on tests. Since the compound took away my nervousness, my upper brain could concentrate better.

It also gives a feeling of well-being. One of my friends, Russ, was a drug-pusher and dealer. I had made up some of the compound into a tea and gave him a double dose; eight ounces. Within three minutes he was actually high.

He believed I had a super dope and talked of pushing it. It was a little hard to convince him that he was just feeling normal, as he hadn't for years. Up until then, the only high he had

above can be done to him at work. This will screw him up with his boss too.

8) Watch your timing. Send in change of address cards so his mail won't be diverted just when all the unwanted stuff will arrive. Don't disconnect his phone just when all the folks are calling about his ads. Do send deliveries and salesmen at odd hours, and send them in one day, but not all at once. Let the pressure build. Make him remember "The Night of the Pizzas" and "The Day the Gravel Came".

I'm sure this has got you thinking of other devilish ways to get someone. These are just the basic pointers and easy techniques. When it is not justified to physically destroy a person, you can easily psycologically destroy them in a blizzard of red tape, bills, magazines, and pizzas.

Scientific American—July 27, 1861

ELECTRICITY FOR EXPLODING GUNPOWDER

In a recent lecture in London by Professor Abeel, F R S., and Director of the chemical establishment of the War Department, he stated that an extensive series of experiments had been made for ascertaining the different forms of electricity which were the most advantageous for exploding gunpowder. The Ruhmkorff coil, by which electricity of high tension is obtained, he considered was the best. What is called the "magnet fuse" has been used very successfully in firing gunpowder with electricity It consists of two fine copper wires, each covered separately with gutta-percha, then both placed alongside, and bound together with an outer coating It is then cut into short lengths, exposing the copper wires at the ends. Moistened gunpowder is placed upon the terminals of one of these fuses when placed in the mine that is charged with powder to be exploded. A spark of inductive electricity sent from a Rhumkorff coil fires the moist gunpowder at the end of the fuse and explodes the charge with certainty It is moistened gunpowder is prepared by mixing the fine grained quality with a dilute alcoholic solution of chloride of calcium A large supply of such fuses, with prepared gunpowder and a large magneto apparatus for generating electricity, furnished a portion of the equipment of the British army during the late China war and the obstructions to the expedition on the Peiho river were cleared away by electrical discharges

The charges of powder which are used for blasting under water and in mines with electricity, are either inclosed in a tin case or a bag of india-rubber, with the magnetic fuse placed in the middle, and connected with the conducting wire to the magneto-electric machine which develops the sparks. For field and mining operations in military engineering, a magneto-electric machine is more convenient than a galvanic battery, and a very small apparatus, made with Berridge's American cast iron radial magnets would, we think, answer admirably for such purposes.

An improvement in the magnet fuse has lately been made in rendering the priming composition more sensitive by using a mixture of phosphide and sulphide of copper and the chlorate of potash. This priming is put upon the terminals of the copper wire, and it is ignited with the smallest size of magneto-electric machines - such as the 6-inch horseshoe magnet and a rotating armature used in America for medical purposes.

known was from the dope he made his living pushing. He was not the person to spread the word.

I next put Paranoid George ("Wheels Of Rage", THE SURVIVOR, Vol. 3) on the compound. For days he was really sharp and efficient. But he stopped taking it and returned to his old security blanket of paranoia. He explained that he had stopped taking it because it kept him from being alert to the plots being hatched against him.

Neither Russ nor George stayed on it. Being artificially high was Russ's natural state His only close friends were dopers and his only income was from pushing. He had a psychological, social and financial interest in being abnormal and so Hell was his chosen condition

Paranoid George, ex-Stormtrooper, ex-biker, was in a constant state of Red Alert. He had no goals to be motivated toward. Normal pursuits held no interest or excitement for him.

In a way, both Russ and George were clinically insane. But the compound worked! And if it worked when taken by two with no purpose, how much more effective would it be with someone with a destiny?

But say you've not had enough shocks to your system to need the compound on a steady basis. Say, also, that your working and personal life is blissfully tranquil so you never need the compound. Think how things will be when the pharmaceutical companies go out of business and the millions of tranquilizer-dependent wretches are cut off and going crazy? You could trade or sell the compound for all the traffic would bear. You wouldn't need to worry about the health food stores running out. You can grow it yourself.

This compound is simple, legal, easily available and much cheaper than tranquilizers. It is a compound of equal parts, by weight, of hops, chamomile, valerian (the basis for Valium) and scullcap. It can be gotten from any health food store. To get it cheaper and in bulk, you ought to order five pounds of each from The San Francisco Herb Co. Twenty pounds of it, a couple of year's supply, will cost only $78.00. Their toll-free number is 1-800-622-0768 in California and 1-800-227-4530 out-of-state. They send U.P.S. collect.

When you get the herbs, powder them in a blender.

There are three ways of taking this combination of herbs. One way is by making a tea. An ounce of each herb is stirred into two quarts of boiling water. As the water resumes boiling after the herbs are stirred in, the pot is taken off the heat, covered and allowed to set for an hour to allow the herbs to steep.

Have another pot ready with a sieve or collander. Put a cloth in the sieve or collander and pour the tea in. After the straining has stopped, twist the cloth so the herbs are in a ball and most of the liquid is out. The spent herb can be combined with the next spent batch and resteeped. This makes the herb go 50% farther.

The first dose should be eight ounces. After that, four ounces every few hours will keep you tranquil, with no side effects.

In the daytime the nerves are soothed so you are very alert. At night, the nerves are soothed so you'll sleep soundly. If you take sleeping pills, substitute the herbs.

If you are really down, the herb will give yu an actual high, as with Russ. After that you'll level off and from then on, if you take it regularly, you'll just be normal. On the other hand, four ounces given to a person who doesn't need it will have no effect at all.

The hops gives the tea a rather bitter taste, which some people can't stand. Others learn to like it.

If you can't stand the taste of the tea, you can take it in its powder form. Actually, in its powder form, the herb goes much further. The only difference is that the tea takes effect in about three minutes, whereas the powder takes ten. The tea is better for getting back to sleep if you awaken in the middle of the night.

To use the powder, take a rounded teaspoonful and dump it on the tongue. Don't breathe in or you'll get a coughing fit. As soon as you get it in, wash it down with water or juice.

Aside from going further, the powder is more portable so you can easily take a packet to work or on trips.

If, for some reason, you can't take it in tea or powder form, go to your pharmacy and buy a box of 100 No. 000 empty gelatin capsules for about $5.50. Open them and pack them very tightly with the compound. About four is the usual dosage.

This compound also cures alcoholism. People are always saying that alcoholism is a disease. Not so. The alcoholic is a depressive.

Alcohol relieves the depression. But it takes B vitamins from the system, causing even greater depression. Drinking, even in the daytime is preferable to the awful depression.

To prove this, take four ounces of your favorite liquor mixed with four ounces of the tea. Sip it along as you might normally do. You might get mellow, but you won't get drunk. Even after eight ounces of whiskey mixed half and half. It works but it's a waste of good booze

If you're trying to quit smoking and you get a nicotine fit, take some of the compound Much easier.

If you're fat and have trouble sticking to your diet take some of the compound when you just have to pig out or go crazy. You'd be surprised how quickly the urge to overeat leaves you.

With a supply of the compound and your nervous system stabilized, you'll be far better able to command or organize than the confused creatures all around you. Remember, in the counry of the blind, the one-eyed man is king.

How Indians Made Their Bows and Arrows

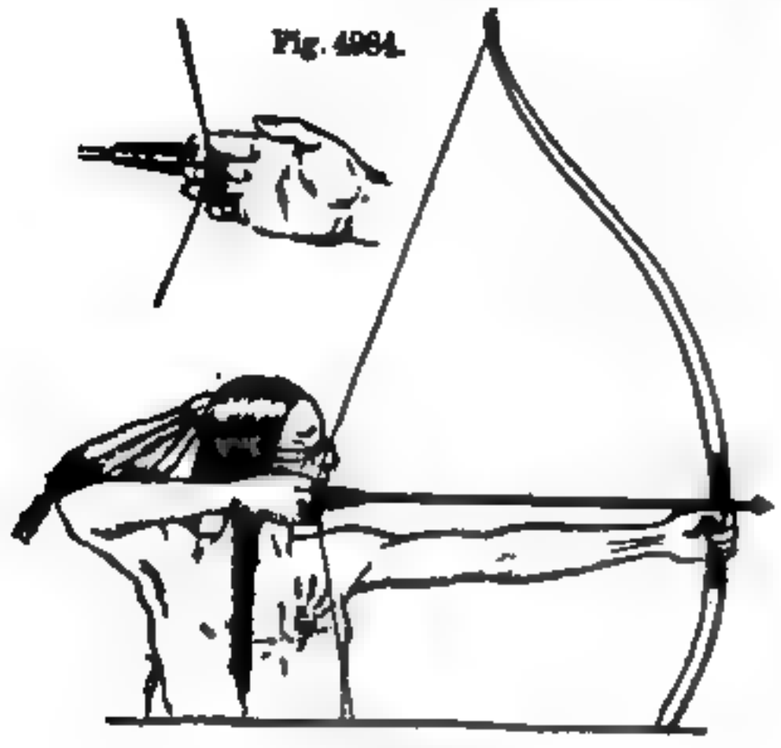
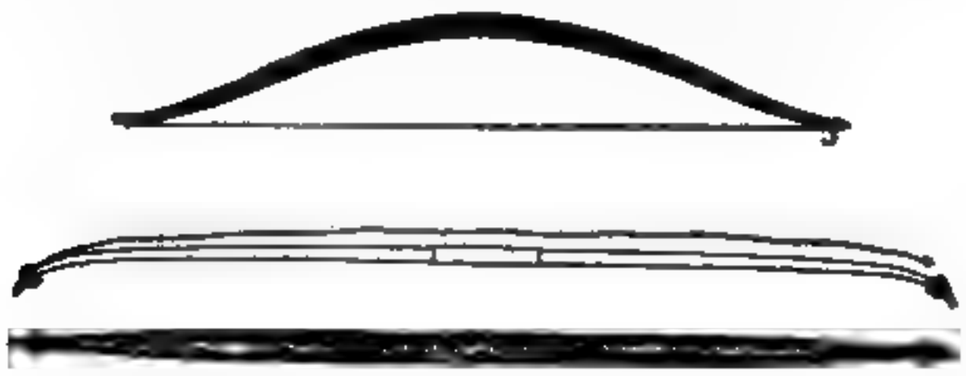


Fig. 4984.

Position in Drawing the Bow

For target work the English bow is far superior to the Indian bow, so that you will do better to make your tackle according to the directions in one of the standard books on archery if you are interested in doing expert target work. The Indian bow, however, does not require the expensive materials used in making a good English bow, nor is it so difficult to construct. Materials for making good Indian bows can be found in almost every part of our country, and the Indian's method of bow-and-arrow making is simple enough to be followed by any good camper.

The best bow-makers on the plains were the Sioux and the Crows. Like nearly all of the other Indians in the West, they used a bow about four feet long. In the East a longer bow was used by some tribes, but the short bow is the common Indian type. This short length is one of the chief ways in which Indian bows



Sinew Backed and Decorated Plain Wood Bows (SI)

differ from the English. The proper length of an Indian bow was sometimes determined by holding the bow-stave diagonally across the body, with one end of it held in the right hand at the hip and the other just touching the finger tips of the left hand when held straight out to the side, shoulder high.

Bows were made of wood, wood backed with sinew, and of mountain-sheep, buffalo, or elk horn. Almost every wood found on and around the almost treeless prairies was utilized for bow-staves, Osage-orange, or *bois d'arc,* as it was called by the French voyageurs, was considered to be the best wood, but, because it grew in a small area and so was difficult to obtain, hickory, juniper, oak, ash, white elm, cedar, ironwood, and willow were more commonly used. The Eastern Indians made their bows from shagbark hickory, ash, red cedar, white oak, willow, birch, and hemlock, while in California hickory, ash, mountain cedar, juniper, willow, elder, and yew were used. The latter is considered to be the best wood of all.

Omaha Bow-making

The Omaha considered the "month of the return of the geese," or February, to be the only safe time to cut green wood for bow-staves. Then the sap was down, so that the stave would season with little danger of splitting by shrinkage. A young ash killed by a prairie fire was especially good bow material, for it was generally well seasoned, and so unlikely to be affected by rain or dampness. When cut and trimmed, the green stave was rubbed with bear's grease and hung from the upper part of the tipi poles in the smoke of the fire, but well out of reach of the flames, until it was well seasoned. When the wood was ready for use it was carefully shaped out with a knife and rubbed smooth with a piece of sandstone. The work might take a week, or on a fine horn bow the warrior might spend a month or more.

Ordinarily, the bows were perfectly flat when unstrung, but they were sometimes gracefully curved. The curves were put in the wood by greasing the part and holding it over the fire until it was quite hot, and then bending it with the foot. It was held in place until cool, when the curve would be permanent. Sinew backing was applied with hot glue to the flat back of the bow, which had been roughened with a stone. The sinew was lapped at the middle and ends and on the middle of the bow. Horn bows were made of thin slices of horn that had been rubbed down until they fitted nicely together. Four pieces were glued together, and a fifth piece fitted and glued over the center. All were then rubbed down until they were of correct proportions, after which they were tightly bound with strips of the small intestines of deer or strips of sinew which were applied when wet. As it dried, the sinew shrunk, so uniting all of the parts and making a bow that was said to be tougher, stronger, and more elastic than a bow of other materials. The chief disadvantage of horn and sinew-backed bows was

that they were likely to become useless in wet or damp weather.

For bow-strings twisted sinew or vegetable fibers were used. The string was tied to notches in one end of the bow, while its noosed end could be slipped over a notch in the other.

For our bow we will take as a pattern a common type used by the Sioux or Dakota. When finished, it will be forty-four inches long, an inch and a quarter wide at the center, and five-eights of an inch at the ends

Fig. 85. Dakota Bow

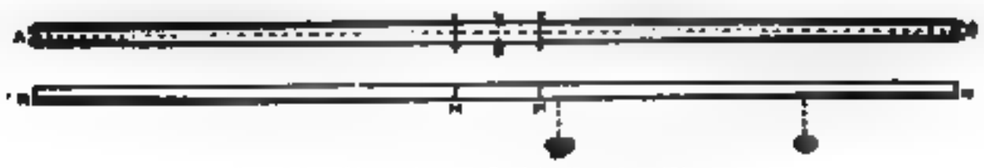


Fig. 86. Bow Stave Laid Out for Planing

(Fig. 85). You may cut and season your own stave, or, if this is not possible, a bow-stave may be purchased from a dealer in archery supplies. A piece of wood bought at a lumber-yard is not likely to prove satisfactory, as lumber is often kiln dried, which makes it too brittle for use. If you cut your own wood, you can do no better than to select one of the woods used by the Indians.

The first thing to do is to dress the sides and ends of the stave smooth with a jack plane. Two of the sides will, of course, be parallel to the grain. Select the smoothest of these sides, or, if you have cut your own stave, the one that was nearest the bark, for the back of the bow. On this side lay off the middle line AB (Fig. 86). Now carefully dress the stave down so that it will be forty-four inches long, an inch and a quarter wide, and three-quarters of an inch thick. Next determine the exact center of the stave, CD, and square lines around it two inches above and two inches below the center mark. This space is for the hand grip. At each end of the stave, now mark off points three-eighths of an inch on each side of the middle line and draw to them the tapering lines YZ. Lay off the same lines on the under or belly side of the bow and plane the stave down to them.

Turn the stave on its side and mark the point N at each end, which is one-half inch from the edge of the back. Draw the diagonal lines MN on each side of the stave and plane down to them on the belly side. Now, with a spoke-shave and plane carefully round the belly so that it conforms to the sectional diagrams. Here again the Indian bow differs radically from the English. In the latter the belly is rounded to a perfect arch, while the Indian bow has almost flat sides. Only the edges of the back are rounded. Notches in the ends of the bow, for the bow-strings, are made as indicated in Fig. 87. They are best made with saw and small round file. The bow-string itself can be made by twisting three triple and well-waxed strands of heavy linen thread together, or it may be purchased ready made from a sporting-goods store.

Don't try to complete the work, especially the planing, too quickly. Many a good bow has been spoiled because the maker was too anxious to try it out. Set your plane fine and go slowly when using it. Test the

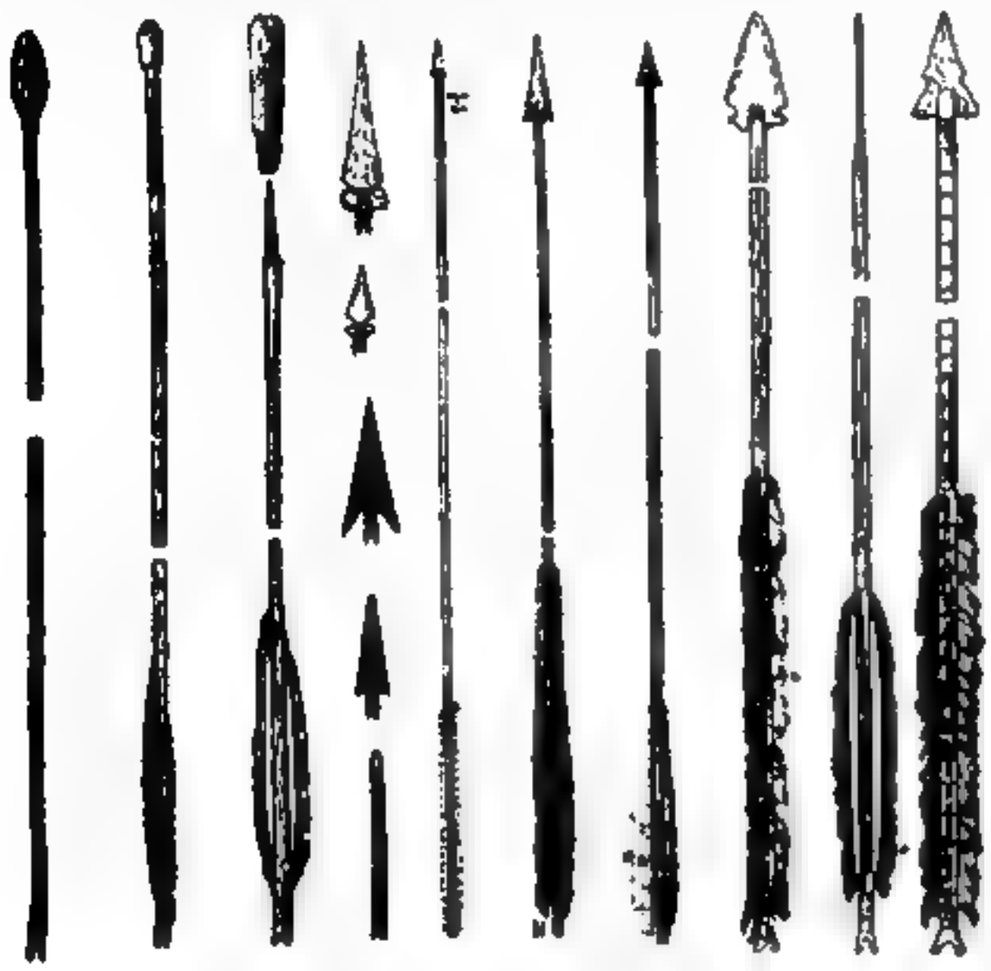
Fig. 87. Bow End with Notches for String

bow carefully, when it is finished, to see that it bends evenly. If it does not, plane a bit off the stronger end. When finished, it may be rubbed with linseed oil or painted with Indian decorations. Keep it unstrung when not in use.

An Assiniboine Bowman (AMNH)

Arrows were more difficult to make than bows. Generally, each man made his own, so that it was only by chance that the arrows of two men in the same tribe would be of the same length. Because of this and also because each man could recognize his own handiwork, the arrows in a carcass served as a means of settling disputes of ownership, which often arose after a great tribal buffalo hunt. Ash, birch, cane, dogwood, willow, and wild cherry-tree saplings were used for arrows. Like the bow-staves, the arrow wood was cut in winter. Sticks were selected that were free of branches, straight, smooth, and about the thickness of one's little finger. They were cut to proper length, put up in bundles of twenty or twenty-five, wrapped tightly

with raw-hide or elk-skin, and hung in the smoke of the tipi fire for several weeks. When seasoned, the bundles were taken down and the bark was removed from the sticks. They were then scraped, smoothed, and straightened. This was a difficult and tedious process. Wherever a crooked place was found, it was greased and heated until the wood could be easily bent, after which it was held securely until it cooled. Sometimes the sticks were drawn through a stone or deer's horn, in which holes had been drilled, as a part of the straightening process. Grooved sandstone polishers, between which the sticks were twirled, were used in



Bird Bolts and War Arrows from Various Tribes (SI)

the final shaping process. A U- or V-shaped notch, or nock, as it is called, for the bow-string was made in one end of the shaft.

The arrowhead was now fastened in a notch in the shaft with glue and a binding of sinew. In the old days it was made of flint, obsidian, and other varieties of stone, as well as of sinew, horn, bone, shell, wood, and copper. Later traders introduced the sheet-iron arrowpoint, which soon displaced the native materials. Arrowheads made of turtle, bear and panther claws were supposed to strike the enemy with magic power as well as with the force of the bow. Sinew arrowpoints were made from the hard sinew that lies along the top of the buffalo's neck and holds his head up. They were considered to be of special value in hunting buffalo because the sinew point striking a rib would go round it, whereas a flint point hitting the bone would often break off. The heads of war arrows were loosely fastened, and so shaped that they would split the shaft and remain in the wound when the shaft was withdrawn.

After the point was in place, the shaft was grooved with three zigzag lines. Just why this was done is not exactly known. Some claim that the grooves represented lightning, others that they caused the wounded animal to bleed more freely, while the Omaha state that they help to keep the straightened shaft from warping.

Finally, the arrow was feathered with two or three trimmed feathers of the eagle, owl, hawk, or other bird. These were glued and bound in place with sinew. The glue used was made from shell of a soft-shell turtle, deer hoofs, or chippings from a rawhide. Between the points where the feathers were fastened were painted bands of color, generally black and red. These colors represented night and day and were a symbol of precision.

Making a good arrow has always been considered a harder task than making a bow, but this need not discourage you. With the materials and tools of civilization you will have a much easier job than did the Indian boy who attempted his first arrow. Cut and season your own wood and follow the Indian method of making arrow shafts or, if you want to make the task as easy as possible, purchase ordinary commercial dowels from a lumber-yard or sash-and-door mill. These are generally made of birch, which is an excellent arrow wood. The size you will want is five-sixteenths of an inch in diameter.

Pick out the straightest and clearest shafts, and with sandpaper remove any slight inequalities they may have. Pick the best end for that in which the head is to be fitted, and in the opposite one saw the nock, which should be one-quarter of an inch deep. Finish it with a small file and carefully round its edges with sandpaper so that it snugly fits the bow-string.

Feathering comes next. Turkey-wing feathers, secured from the butcher at Thanksgiving and Christmas, or purchased from a millinery supply house, are the best. Use those from the same side of the wing for the same arrow. With a sharp knife split the feather. Then clean out the pith and with scissors trim off the excess quill. With the scissors cut feathers to shape as indicated in Fig. 88. The full length of the finished quill should be six and a quarter inches; that of the vane, five and a half inches. The latter is one-quarter of an inch wide at the front, and three-quarters of an inch at the rear. Finish them in sets of three and put them aside until you are ready to feather the arrows.

With a pencil, now mark off on the shaft the places where the feathers are to go. One inch and a quarter from the end of the arrow draw a circular line. This is for the rear binding. Four and three quarters inches from this draw a similar line which marks the beginning of the front binding. At right angles to the nock draw a perpendicular line which indicates the position of the cock feather. Two similar lines are drawn equidistant from this, for the other feathers. When all are set they will appear as in Fig 89.

We are now ready to glue and bind the feathers. Put a thin coating of glue on the feather and on the pencil line indicating its position, and allow it to partially

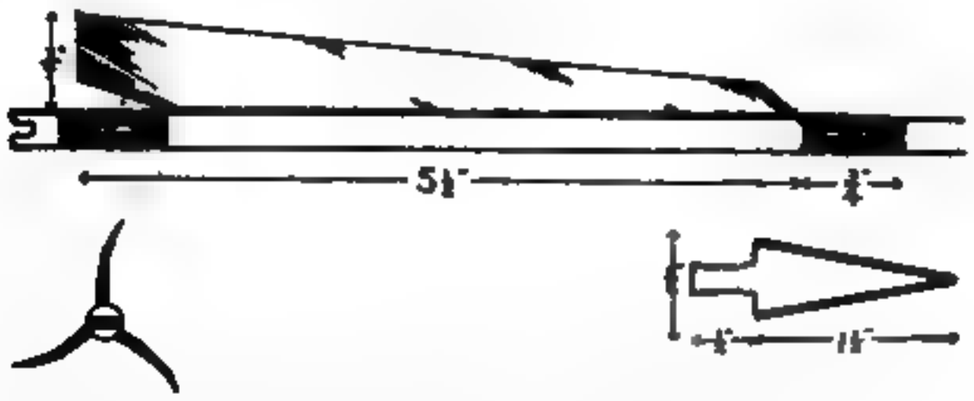


Fig. 88. Method of Feathering Arrow Fig. 89. End View of Arrow Fig. 90. Iron Arrow Point

set before pressing both together. Pins may be used in each end of the quill to hold the feathers in place

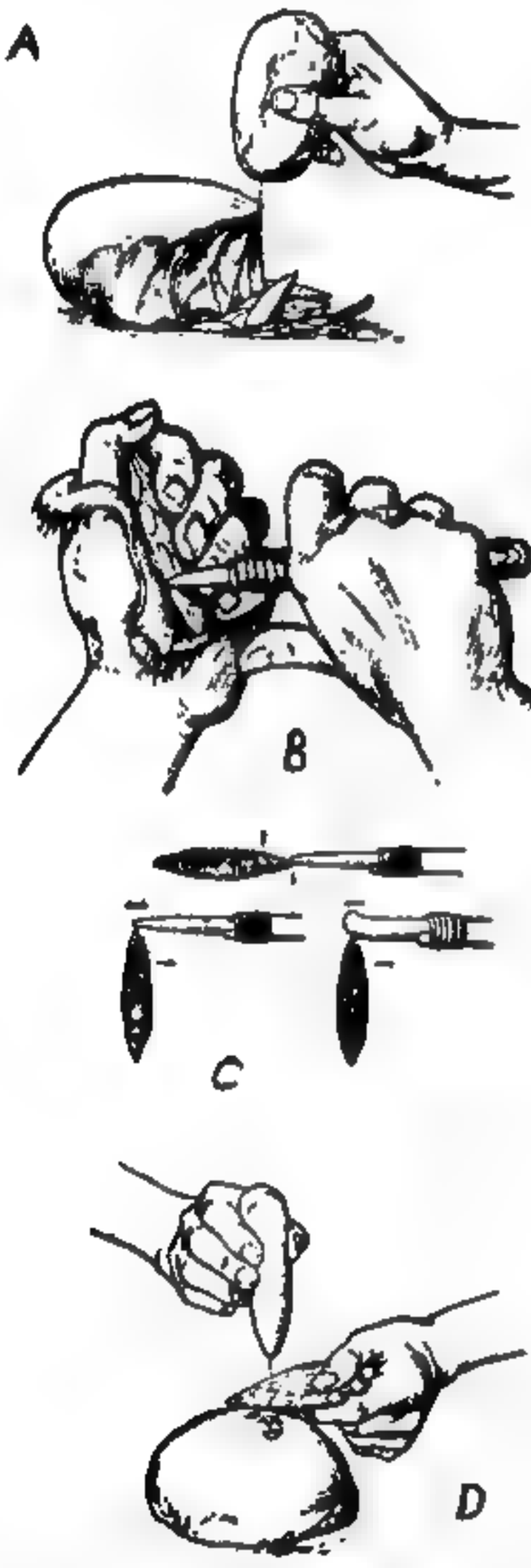


Fig 91 Chipping Flint Arrow Points (BAE) (A) Making Flakes (B) Chipping a Flake with a Bone-pointed Tool (C) Position of Tool and Flake in Chipping (D) Chipping with a Hammer Stone.

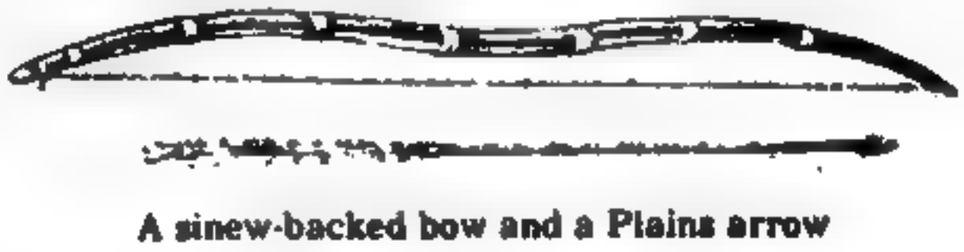
until all three are glued to the shaft. When they are in place baste them down by a spiral binding of cotton thread wrapped between the bristles of the feather. If necessary, adjust the position of the feathers as this basting is put in place. When the glue dries, remove this basting and wrap and glue the permanent bindings of colored silk thread to each end of the feather. The hardest part of the work is now over.

Now for arrowheads. The easiest to make are those of iron, like the ones the Indians first got from white traders and which they later made from scraps of iron that happened to fall into their hands. These varied in style in the different tribes and according to the use to which they were to be put. For them you will need some one-sixteenth by five-eighths inch spring steel or band iron, which you can get from a hardware store or blacksmith shop. With a hack saw roughly shape the point according to Fig. 90. Use a file to trim up and sharpen the edges and to make the notches for the binding cord in the shank.

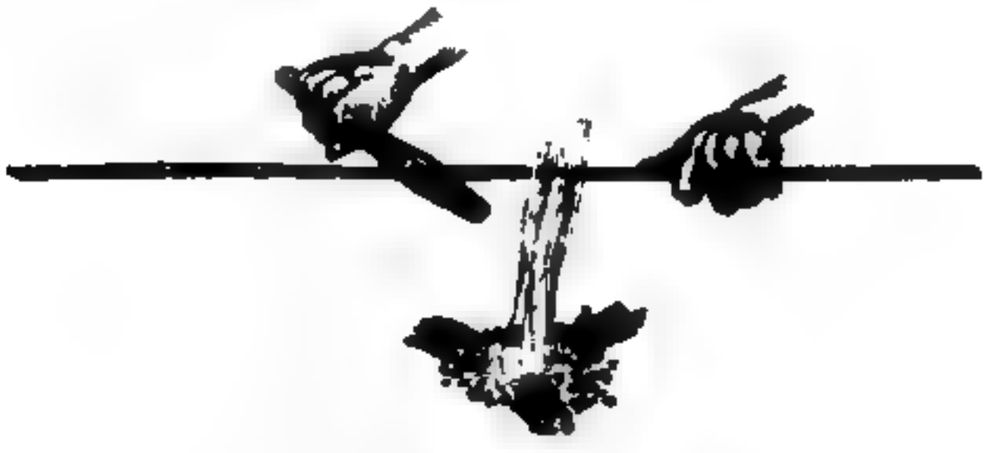
Round off the end of the arrow and saw a notch in it three-quarters of an inch deep, to receive the head. Glue the point in place and bind it, while the glue is soft, with button-hole silk thread. You now have an Indian bow and Indian arrows such as were carried on buffalo hunts and the war trail by the warriors of the plains a hundred years ago.

Chipping an Arrowpoint

Some day you may wish to try your hand at chipping out flint arrowheads. The drawings in Fig. 91 show how to do it. Flint, quartz, or obsidian, suitable for this purpose, can be found in almost every part of our country, and if you have trouble in finding suitable natural material, remember that with care and practice good heads can be chipped from pieces of glass bottles. The equipment needed is simply a pad of heavy leather for the palm of the hand and a chipping tool of deer horn, bone, or steel. The piece of flint or glass to be chipped is held in the left hand on the pad and the chipper is pressed firmly against the edge of the flint until a chip breaks off. Take off but a small chip at a time. Patience and care are needed if you are going to master this ancient art.



A sinew-backed bow and a Plains arrow



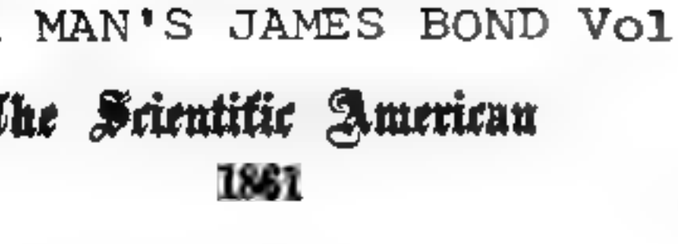
Straightening an arrow shaft

Iroquois bow and arrow. The hole for the bowstring is unusual.

The Scientific American
1861

The famous congreve rocket, which was invented in 1804, was cobdemned by the Duke of Wellington as being more dangerous to the army that used it than to the enemy, from the uncertainty in the direction of its flight. It has often occurred to us that the principle of propelling rockets might be applied to cannon shot, in connection with a tube of sufficient length to insure the flight in the desired direction, and we here illustrate a plan invented by Mr, William Hale, of England, for accomplishing this.

The rocket-shell is represented in Figs. 1 and 2. The shell, *a*, has a long iron cylinder, *b*, attached to its rear end; this cylinder being filled with meal powder, *s*, compressed, so that it will burn slowly. The burning of this powder generates hot gases which exert a powerful pressure against the whole interior of the cylinder, and by making holes in the rear end of the cylinder, a portion of the pressure is removed from this part, leaving the pressure against the forward end not fully counterbalanced, which according ly drives the missile forward in that direction. A central rod, *d*, holds the plate, *f*, securely against the rear end of the cylinder, and serves to distribute the propelling powder in the annular chamber around this rod. A space is left within the cylinder around the outside of the powder, so that the powder may burn from its external surface inward, and when the fire reaches the central rod, it lights a fuse which explodes the powder in the shell



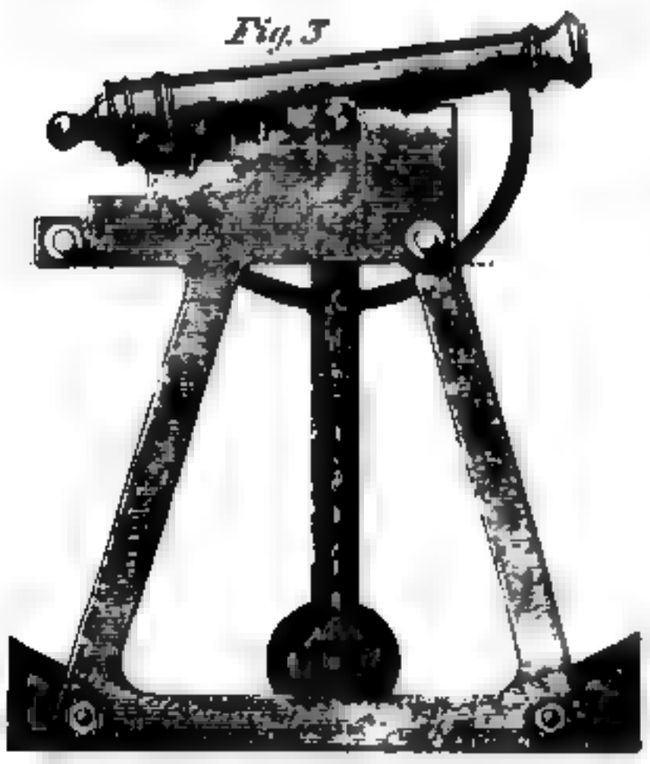


Fig. 3 represents the apparatus for starting the shell in the desired direction of its flight when used on board ship. A slit is made through the deck, *k*, of the vessel for the sliding back and forth horizontally of the frame, *k k*, and pendulum rod, *c*, the gun, *b*, being supported on the rollers, *r r*, which run upon the deck by the sides of the slit. A curved railway *g*, is fitted to support the rolling pendulum, *d*, so that as the vessel rolls, this heavy pendulum will preserve its vertical position, and thus keep the gun in a horizontal position, or at any angle of elevation desired.

Mankind were never more earnestly engaged in improving instruments for destroying each other than they are at the present time

The Fantasy of Survival Through Deadly Force

By KURT SAXON

The first network TV show I was on (Speak Up America) featured a segment with Mitch Werbel, of Cobray International. He runs an all-inclusive combat school to help mostly white-collar types act out their macho fantasies.

He said, and I must paraphrase since I didn't record it, "I don't go with storing food and such. The only way you're going to survive is to learn how to kill".

The TV people may have edited out any qualifying statements. I hope so, because, as it stands, that attitude is stupid and actually destructive of long-term survival goals.

Two popular scenarios give a lot of people the idea that killing one's fellows will be all the rage. The first is that eminent socio-economic collapse will turn every neighborhood into a battleground between the haves and the have-nots; the stocked-up versus the improvident, the ants versus the doomed grasshoppers, etc. After a few weeks of chaos the government will reorganize and reinforce law and order.

The second, and silliest, is the scenario which tells of the Survivalist seemingly dying of old age after interminable battles with a never-ending list of enemies. The world has sunk into perpetual barbarism. Valhallah!

The first scenario appeals to urban types who can't conceive of a world they don't fit into. Their city is eternal. It needs them. When the chaos comes they will defend it from foreign enemies and, at the same time, liquidate the internal vermin dragging it down.

I compare the modern city to the lower bowel, a collection place for the dregs and waste of the body. The majority of urbanites are the used up and/or the useless. By the time the surplus population of your city is wiped out, it will no longer, and probably never again, be a functional metropolis. Your livelihood will be gone and you will be just another refugee with little chance for safe passage to a rural haven. Your only contribution to the future will be a negative one on your part. If we are lucky, you will simply have killed some sub-humans who might otherwise have become a threat to valuable rurals.

Disabuse yourself of the idea of government help in reconstruction. The Feds are so obsessed with catering to the helpless and hopeless that you are already enslaved on their behalf. "From each according to his ability", Acts 11:29, "To each according to his need", Acts 2:45, is the bottom line of the Bible, Karl Marx and our Federal Government. Hope against hope that the government is destroyed before it gets around to "helping" you.

The Gung-ho Survivalist who fancies himself an eternal warrior or warlord, keeping himself alive by looting urbanites and then rurals is plainly and simply doomed. His mastery of martial skills will leave him about as useful as a muscle-bound sports "hero" in a machine shop.

After the collapse, only the versatile will be useful. The narrow specialist, whether he is in high technology, or a Brinks guard will serve no more purpose than teats on a bull.

The danger to the weapons freak is a false sense of security. He believes he can defend his holdings from all comers, or, if he has none, he can take what he needs from others not so well armed, or he can hire out.

Defending an untenable position is stupid. Surviving urbanites may only be refugees, leaving most of their holdings behind and finally being killed off by hostile rurals.

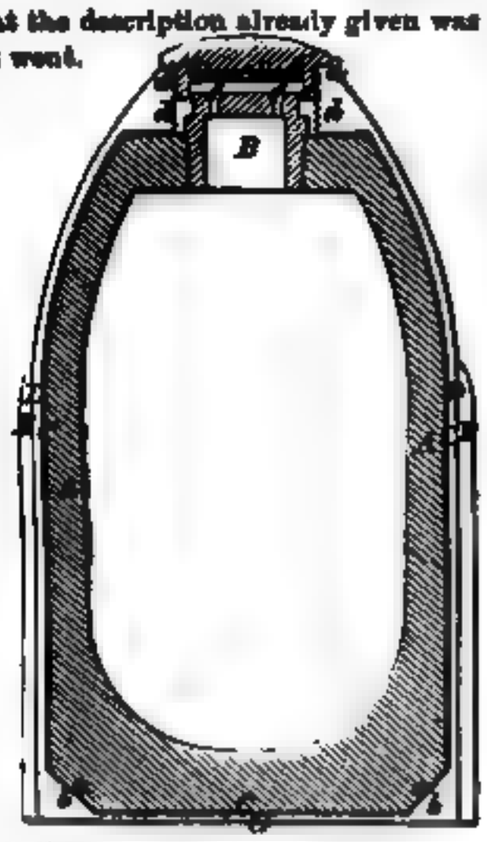
Hiring out will only be temporary. The Great Culling will exterminate those with the need to take what they haven't earned.

Another thing to consider is that if your only skill, your obsession, is killing, you won't be allowed to survive. I recall a story I read about the WW II Rangers. It seems two of them were on leave and in a bar. A customer tapped one on the shoulder, meaning to ask for a light. The Ranger spun around and commenced to injure him seriously. That set the other Ranger off and the two destroyed the bar, killing a couple of the merrymakers and injuring several more.

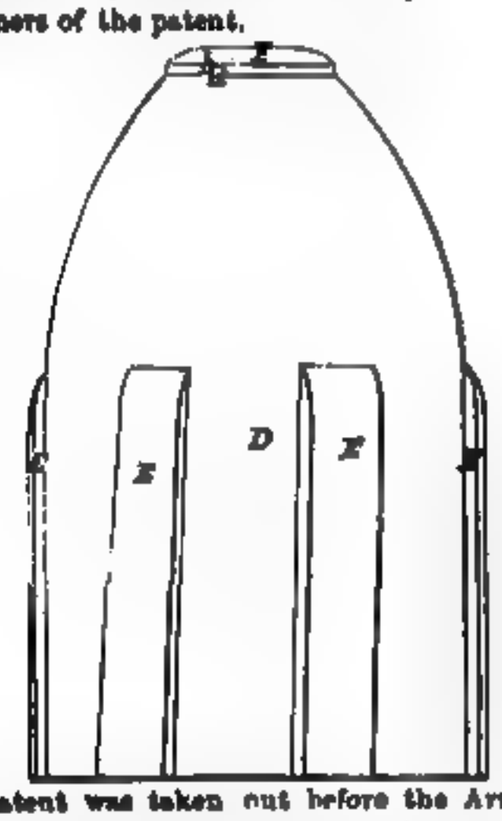
Scientific American—Aug. 17, 1861

SAWYER'S PROJECTILE.

We have published two descriptions of this famous shell, by two of the inventor's rivals, and now we publish his own with a full illustration. It will be seen that the description already given was correct as far as it went.



This shell was patented in 1856, by Sylvanus Sawyer, who has since conveyed one undivided half to Addison M. Sawyer. The Messrs. Sawyer are now the sole owners of the patent.



The patent was taken out before the Armstrong gun or the French rifled cannon were known.

The following is a brief synopsis of the Sawyer shell :—It is fired from a rifled, muzzle or breech-loading cannon. The shell is of iron, coated with a peculiar alloy, D D, soft enough to prevent any abrasion of the metal of the gun; and at the same time is so compounded as to prevent any *leading* of the gun. In size, it is so constructed as to slide readily into its place in the gun while the base of the shell, G, being a plane with a beveled edge, *b*, when acted upon by the powder, has so much of the composition upon the bevel upset as is necessary to prevent windage. Thus the whole force of the powder is applied to the propulsion of the shell and all abrasion of the gun, which is observed in the discharge of ordinary projectiles, is avoided, and the use of a patch is entirely dispensed with.

The shell, which is elongated and conical at the head, invariably moves point foremost. This result was considered impossible to be attained, until demonstrated by experimental practice with this shell. Upon the point or head, F, is a cap or screw top, A A, filled with fulminate or percussion powder, *e e*, which explodes on concussion—by impact with any resisting substance—the alloy, *d d*, forming the point of the shell yields by the blow upon any hard substance, and communicating the fire to the powder within, thus forms the quickest and most certain mode of exploding a shell that has ever been devised.

This shell can be used with the ordinary time fuse: and as a case shot, from its greater capacity, is far superior to any other shell.

Scientific American—June 29, 1861

[illegible] for Soldiers.

In the Crimea, the troops which resisted privations and fatigue most successfully, were those commanded by colonels who were careful of their soldiers. For example: of two regiments which left the camp of St. Omer at the same time, arrived together in the Crimea (in the month of October, 1855), encamped side by side, having submitted to the same atmospheric vicissitudes and performed like service, one of them had preserved, on the 1st of April, 1855, 2,224 soldiers, out of a force of 2,676 men; whilst the other, with a force of 2,827 men, had left to it only 1,289. This account includes those who died from disease, and not from wounds received in battle. In the navy the commander of a vessel watches over the composition of the food of the crew, and moreover, respects scrupulously the hour for breakfast and that for dinner; never is it delayed, anticipated or interrupted.

It is desirable that the same scruples should pervade the army, and that these wise measures for the preservation of health should never be infringed without a clear and absolute necessity. Rewards are given to colonels of cavalry in whose squadrons is preserved the greatest number of horses, which results in an excellent and profitable emulation. Similar results, but still more important and happy, would be experienced, if like rewards were bestowed upon the colonels whose battalions were distinguished for the healthy condition of the men.

They were so keyed-up and over-trained they were psychotic. That incident and others caused the order to go out to put them in the forefront of every battle from then on. Few came back from the war.

I often see TV clips of Soldier of Fortune get-togethers. There they all are, banging away with whatever degrees of automatic weapons the local laws allow. Then they show off their hand-to-hand prowess and throw each other all over the lot. Then the knife fighting, Kung Fu, etc.

Most of them are decent men with regular jobs, just hobbying. They're all right, but there are some among them who live for the day when they can be free to kill anything that moves. I hope they all do yeoman service in the coming urban hellishness. But they will not be needed for long in a rural environment.

Take Boone County, Arkansas for instance. Harrison is the county seat. Here, we have a good police force. We also have a Sheriff's department, a National Guard unit, an Army Corps of Engineers and State Troopers quartered here. Unlike urban lawmen, they won't desert to care for their own families in other areas. They live in the community and are a part of it.

Nearly every able bodied civilian is a veteran with good military training. Also, nearly every able-bodied male was raised as a part-time hunter. I've never met a man here who didn't have several guns. Boone County is a garrison state without meaning to be.

There are seventy miles of armed hillbillies between me and the nearest city. Aside from having it out with wandering infiltraters, I'll probably see no action at all, if I'm lucky.

In my downplaying of the importance of weaponry I don't mean to belittle readers of **THE POOR MAN'S JAMES BOND** or **THE WEAPONEER** or any other such works. Learning to make things for yourself, even weapons, is a step forward for one otherwise totally dependent on others for one's manufactured wants and needs and especially one's safety.

I think the average Karate buff takes it up on the chance that he'll eventually confront a couple of punks who might otherwise hurt him. So if you buy books on weaponry against just such an emergency, that's fine. At least you don't use up all the time and money it takes to get a Black Belt.

But your brain is your most powerful weapon. You shouldn't limit it to the handling of emergencies that might never arise in your case.

Part of the reason for this editorial is that I checked and found that only about 20% of you have a full set of **THE SURVIVOR.** When the mail stops and **THE SURVIVOR** is no longer available, a set would get you a place in any survival group or community.

In the meantime you can use your weapons-making skills to turn out more domestic products for sale. You'd also be surprised at the money you can save by making things you need now, all the gifts you're committed to giving and even all the weaponry in **THE SURVIVOR.**

So don't limit your imagination to weaponry. Don't limit your intellect to serving some small segment of our doomed Establishment. A set of **THE SURVIVOR** would take all the limits from your mind. You can not only get your thinking better organized to deal with the coming upheavals but you could plan on being on the ground floor of the next Industrial Revolution.

Scientific American—June 22, 1861

HOW PERCUSSION CAPS ARE MADE.

The invention of percussion locks for firearms was as great an improvement upon the flint lock as the latter was upon the old match lock. Its inventor was a pious man devoted to the arts of peace—a Presbyterian minister whose name and the date of whose patent are recorded on page 340, current volume of the SCIENTIFIC AMERICAN. The percussion powder was

ventor of percussion caps is alleged to be Joseph Manton, an Englishman, who took out a patent in 1818. His first caps were made of small copper cups charged with percussion powder similar to those still in use. Other parties soon tried to obviate his patent by using small copper discs charged with percussion powder, but these were held to be covered by the patent. The cap was a great improvement upon the loose charge of a pellet of percussion powder placed in the nipple, and all firearms, except those furnished with Maynard's primer, or explosive cartridges, are adapted for percussion caps. An account of the manufacture of percussion caps will be interesting and instructive, especially as no clear description of the operations has hitherto been published, as far as we know

Percussion caps are formed of a soft copper alloy, which is principally obtained from France in the form of thin sheets. The first operation is cutting these sheets into narrow strips with roller shears. The next is punching out the blank caps, and striking them up in dies in a machine. The strips of copper are fed in between small rollers over a small table which has four dies in it. A punch comes down, and at each stroke cuts out four blanks in a row from the strip. Each blank is formed like a Maltese cross, and just as it is cut out, a small round plunger pin strikes it in the middle, forces it into a small conical die in the table below, and thus forms it into a cap. At the very instant the small die plungers are raised, a puff of wind from a blower throws the four caps out of the dies into a receiving box, and the dies are ready for upsetting another set of blanks. Sufficient copper is left in the strips after punching to enable them to be carried forward to clear the table at each stroke. Different dies are employed for caps of different forms.

The next operation is that of charging and stamping the caps. For this purpose, a strong steel plate containing about 1,000 small conical holes or dies to receive as many formed caps is used; it is laid upon the table of another small machine, a girl takes several handful of caps from the box of the die press, spreads them over the steel plate, and by a few rapid motions of the hand, they all sink into the holes with open mouths, ready for the percussion powder. This is a compound of fulminating mercury, of potash, sulphur, and a little ground glass. This is spread dry and loosely by hand, like meal, over the entire plate, and each cap is filled to the mouth The surplus is then swept off with a brush from the surface of the plate. Tin foil is now laid upon the top of the plate covering the powder in the caps. A series of small plungers, each of such a size as to fit into a cap, are now forced down upon the charged plate, cutting through the tin foil, and carrying a piece into each cap. The powder is pressed down by these plungers into a very small space at the bottom of each cap, and the pressure is sufficient to stamp the name or number on the top of each, by forcing the metal into

ESE OWS

regular arch-
modern cross-
"gold" almost
They are good
stop anything
described in
uction except
a steel bow.
g. 5.
he wood bow
us very much
. 8. Start the
stock includ-
wn in Fig. 9.
ute pine and
release, using
on either side
haper cutter,
ole. Lacking
with a router
ortise for the

ABOUT

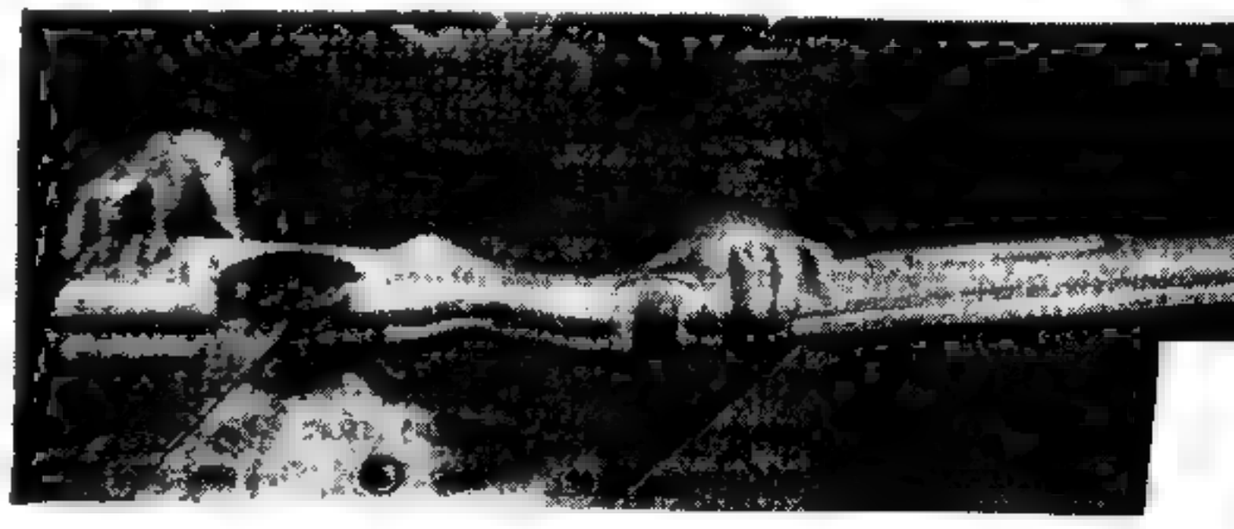
Bow	Steel Bow
s	4¼ lbs.
s.	110 lbs.
ds.	250 yds.
0 yds	About 60 yds
	1¼"
"	28½"
"	23 "
3½"	5/16" X 13½"

SHOOT THI *Modern* CROSSBO

IF YOU can't hit the bull's-eye with a
er's bow and arrow, try one of these n
bows and you'll find yourself hitting the
every time from distances up to 60 yds. T
for hunting, too; a 160-lb. steel bow will
short of an elephant. Two models are
this story, both very similar in constru
that one has a wood bow and the other
Comparative data is given in table of Fig

Stock for wood bow: The stock of th
can be made from white pine. Its shape
like a modern rifle as can be seen in Fig
job by making a full-size drawing of the
ing the full detail at the trigger as sho
Transfer the stock outline to 1⅞-in. wi
saw it out. Drill the hole for the string
an expansive bit as in Fig 2. Recesses
of the hole are run in with a straight s
Fig. 3, the guide collar rubbing the h
shaper equipment, the recesses can be cut
bit in a drill press. Fig. 4 shows the m

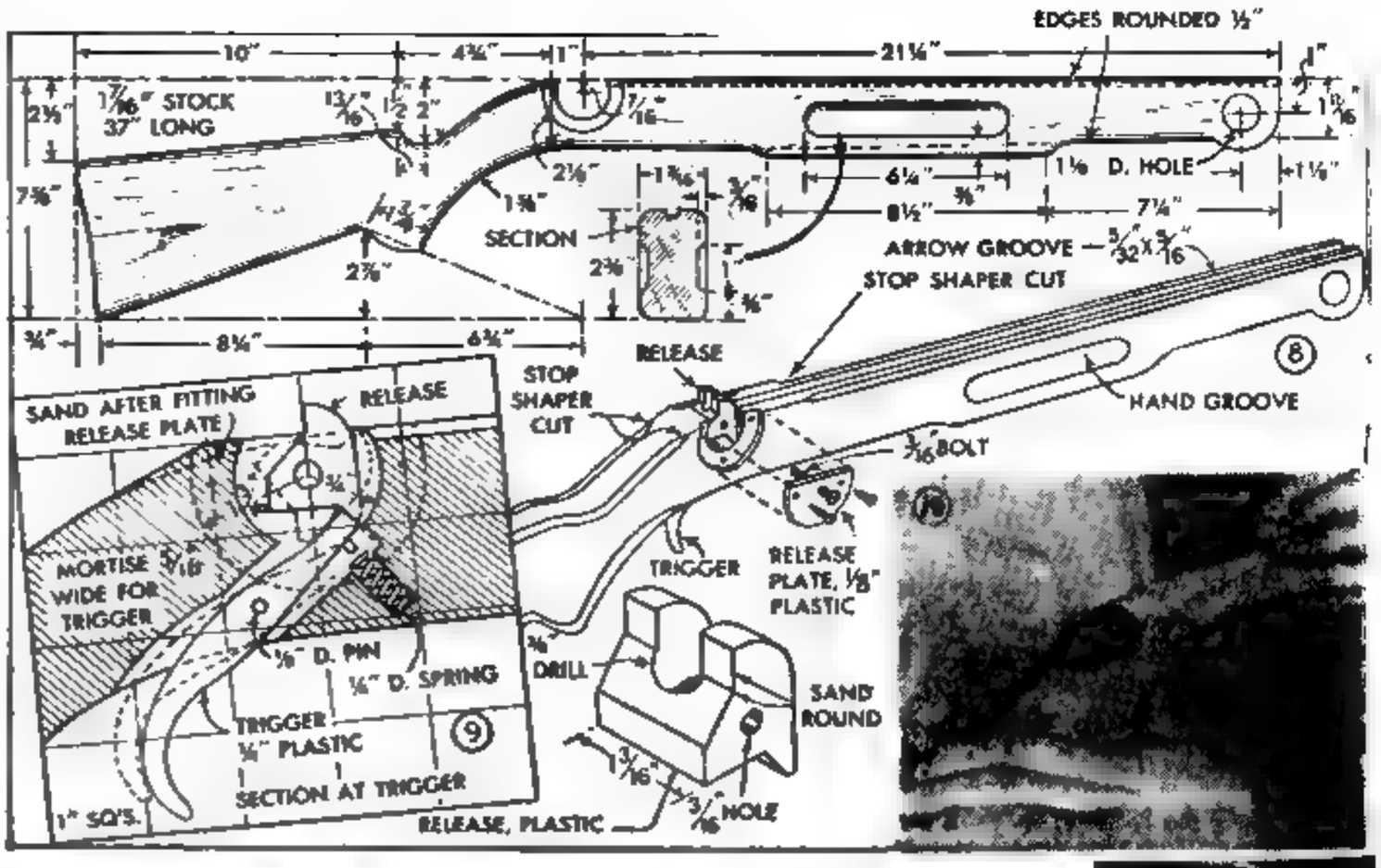
Data	Wood
Weight of crossbow	3 lb
Drawing weight	48 lb
Maximum range	160 y
Effective target range	About 4
Penetration in white pine	⅜"
Length of stock	37
Length of bow	54
Size of arrow	5/16" X



the proper figure cut in the bottom of each hole. The pressure to which the percussion powder is subjected by this operation is so great, that strangers are always surprised on witnessing it. Sometimes caps explode by the pressure, but as the plates are strong, no damage of any consequence results

The next operation is that of coating the inside of the caps with varnish to render them waterproof and prevent access of the atmosphere to the powder. For this purpose the plate containing the caps is placed in another machine, which has a series of little dippers, that take up the varnish from a receptacle, and supply each cap with its proper quantity The plate containing the caps is now removed into a warm room, when the varnish dries, and the caps are then emptied out of the plates, and put up for market Quite a number of steel die plates are employed in the process, and a set of small machines required for the entire operations of cutting the copper, punching, upsetting, charging and varnishing, will make about 400,000 caps per diem

We have described the operations from the beginning to the finishing of one set of caps. Several sets of machines are generally run in every percussion cap factory. The demand for such caps has been so great for several weeks past, that the factories have scarcely been able to meet it by working over hours. Some caps are made with top flanges, some are perfectly smooth, and without rims, and others are corrugated. These forms are all produced by the die machine.



Cocking lever is required when bow pulls over 100 pounds. Bows that pull less than this weight can be set by hand

Stenches For All

by Kurt Saxon

In these days of fear of offending, people have gotten used to nothing but good smells. So when a stench that can move mountains assails the pampered nostril, the poor baby just can't deal with it. He, she or it must needs go home, or if already at home, move. A good job done on the family or company car gets the vehicle junked.

I once had an experience with Mercaptan, an oil distillate, when a friend threw some into the car of a woman I was staying with. (She had had his child aborted and he had wanted so badly to be a daddy).

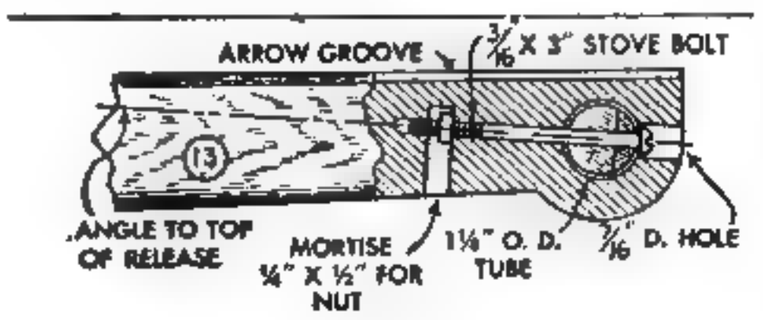
I was awakened by the most horrible odor of garlic and skunks. It was hard to trace to its source as it seemed to be all over the house. I finally traced it to her car parked outside in the open air. He'd opened the car door, poured about an ounce in the back and closed the door.

Since it was that strong in the house and outside, from a closed car, I wondered if the nieghbors would notice. I looked and saw a sheriff's car parked at the curb a full block away. I walked down there and sure

trigger being cut. Run in the arrow and hand grooves, using suitable shaper cutters. Then, shape all the edges ½ in. round, stopping about 1 in. from the release hole as indicated in Figs. 6 and 8.

All working parts of the action are made from plastic. Dimensions given will provide sufficient strength for bows up to 60 lbs. drawing weight. Over this weight, the release plates should be 3/16-in. plastic and the trigger should be made from 1/16-in. metal. After fitting the release plates, the top of the stock is sanded down to about the dotted line shown in

Wood bow is 54 inches long, made from lemonwood. Approximate section for 40, 60 and 80-lb. bows are given in table below. Bow is strengthened at center by steel sleeve



enough, the woman had called the law. Naturally, I didn't know a thing, but can you imagine, a full block away?

As soon as I could, I got a pint of it and I don't know of a present source but maybe Aardvark has access to it.

The stuff I have is so volatile that the bottle I have is dipped in wax and stored in a paint can stuffed with paper and the lid banged on tight. Even so, a sniff at the can's edge tells me it's still in there.

I meant to foul a printing corporation in Dallas and hoped to carry it in a wax-dipped hypo. The stench came through the plastic and wax something fierce so I couldn't carry it that way. Then I put it in a 4 cc vaccine bottle with a rubber cap, the kind hypos are filled from. Not good enough. I finally put the bottle in a 4 oz. glass vitamin bottle filled with rubbing alcohol with a tightly screwed-on plastic cap. That's what it took to block the smell.

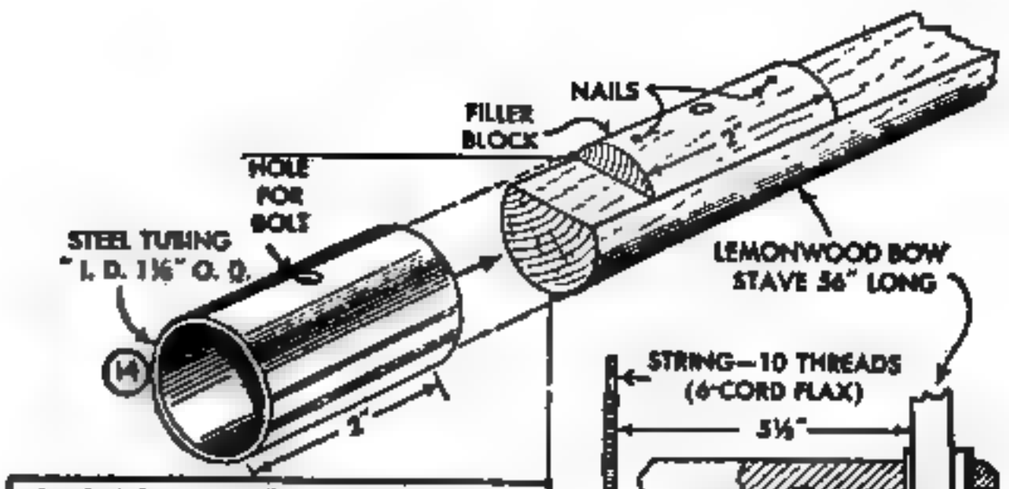
The first stench is the smell of rotten eggs. The best way to get the smell of rotten eggs is to rot eggs. Break two eggs in a jar and add an equal volume of urine. The uric acid gives it that special something.

Stir well and leave the jar uncapped for about 24 hours. Then cap and set it in a warm, dark place for a couple of weeks. Actually, it takes a long time for eggs to rot and if the proper bacteria isn't there to settle in it the result could be disappointing.

I had a batch going for a month before it really turned. But when it did it was a horrific wonder. Just a sniff made me gag and that room stank until the next day, even though I'd only had the jar open for a few seconds.

When the stench is at its height, the next step is to remove the solids. Cut a piece of cotten cloth 12 by 16 inches. Take everything outside, put the cloth across a plate and pour the mess in its middle. Quickly roll the cloth into a loose tube and, holding both ends, twist it until all the fluid has run into a jar. Any fluid on the plate can also be poured in. Dispose of the cloth.

Rotten meat is another really disgusting smell. Put a quarter pound of hamburger in a jar and let it set for

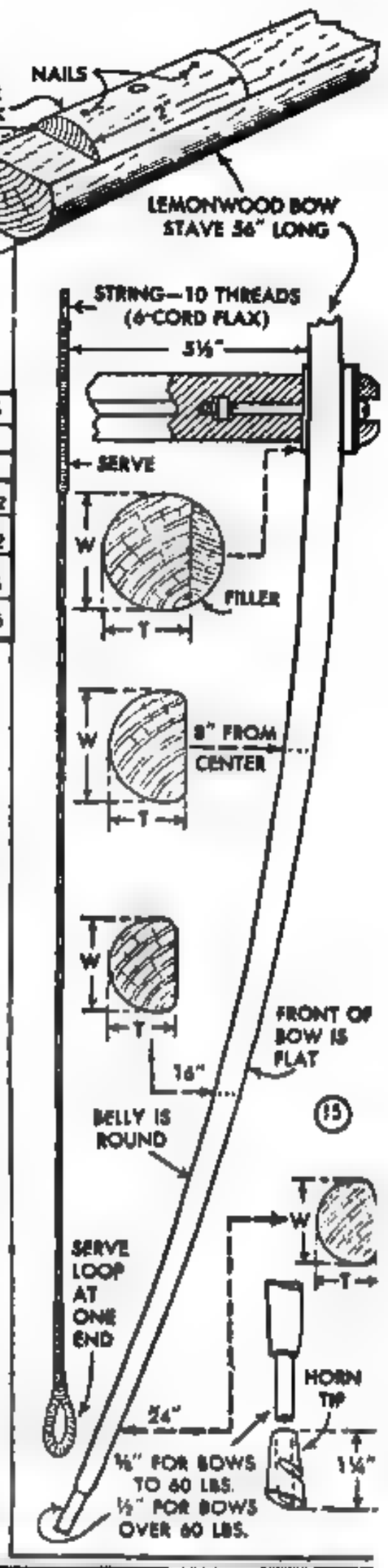


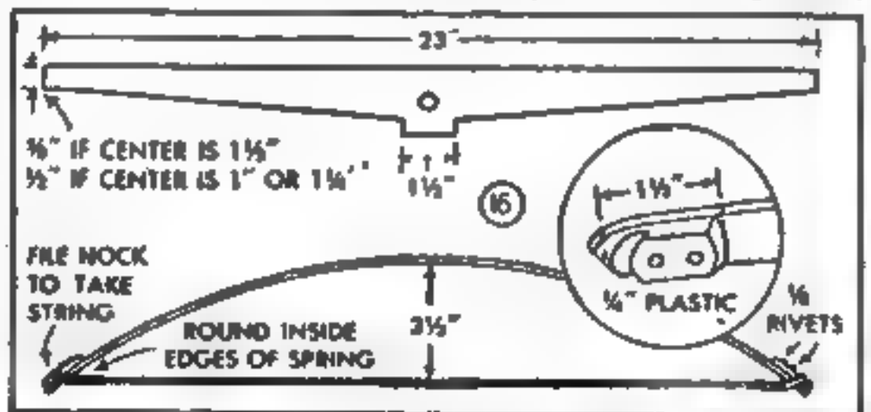
DIMENSIONS OF 54" LEMONWOOD BOWS						
Station	40 Lbs.		60 Lbs.		80 Lbs.	
	W	T	W	T	W	T
Center	1	¼	1	13/16	1 1/16	29/32
8-inch	15/16	21/32	15/16	11/16	1	25/32
16-inch	13/16	9/16	27/32	19/32	29/32	1/16
24-inch	5/8	15/32	11/16	½	¾	9/16

Fig. 9. Fig. 10 shows the operation. The sharp edges are then faired into the shaper cuts. Be careful in fitting the release plates so that screws will not interfere with this sanding and rounding operation, in other words, keep the two top screws low. The plastic trigger has a small lug on the underside near the upper end to fit inside the trigger spring, as can be seen in Fig. 9.

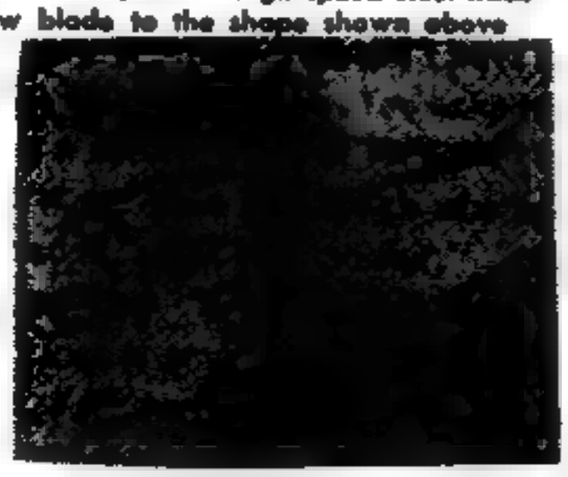
The wood bow: The bow is made of lemonwood to the approximate sections given in the table. The 60-lb. pulling weight is recommended. The 80-lb. bow is very close to the maximum stress which can be imposed on lemonwood in this length of bow. Shaping of the bow follows standard practice, flat on the front, round on the belly. A section 2 in. long at the center is made full round by adding a filler block, as shown in Fig. 14, this section being enclosed in a steel tube. The completed bow is fitted through the hole at the front of the stock and is fastened with a 7/16-in. bolt as shown in Figs. 11, 12, 13 and 15. Note in Fig. 13, that the bow is tilted slightly so that the string when pulled back comes to about the top of the string release. If desired, the bow can be made by trimming down a regular 6-ft. bow of about 30 lbs. drawing weight. When this is shortened and the ends trimmed down a little, it will pull about 60 lbs. at 21-in. draw. Equally practical, a flat bow can be used instead of the stacked type shown, mounting the bow in a notch cut at the end of the stock. In any case, the bow must be worked carefully and broken in gradually, tugging a little on the string and then releasing until the full draw is obtained.

The steel bow: The steel bow, Fig. 1, does not have the silky, smooth shooting action of a good wood bow, and pound for pound the wood bow will outshoot it. Against this, the steel bow offers compactness and power, and, all





The steel bow is compact and powerful. Metal is obtained from a light automobile spring, which is sawed with high-speed steel hacksaw blade to the shape shown above



24 hours uncovered. Then break it up and cover it with its own volume of water and let it set for a couple of weeks with the lid on tight. Refine the finished product the same way as with the rotten eggs.

The same process goes for fish. Rotting fish will drive anyone up the wall or out into the street.

The fact that these stenches can take several weeks to generate shouldn't bother you. Actual working time is only a few minutes and, considering the small cost and the effect it has, makes it the cheapest wat to emotionally devastate an opponent.

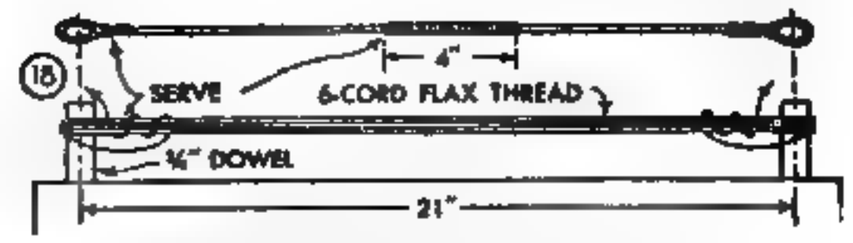
If you mean to dispense the stench with a hypodermic you'll want it to be clear of foreign matter so it doesn't clog the needle. For this you'll need a coffee filter and holder, both of which can be bought from any supermarket for a couple of dollars. Put the filter in the holder over a small jar which will accommodate its opening. Help the filter along by giving its surface as much room as possible between it and the holder. To do this, put toothpicks or straws around the inside of the holder.

Do all this outside and don't let it set there after it's filtered. You don't want the smell to be wasted in the open air.

Aside from just slopping the stench at the target, it s best to use a hypo. This will enable you to squirt it, covering a wider area and with less chance of being noticed. Also, with the inch long needle, you can squirt it into locked buildings through double doors or under the door, into locks, in cracks of walls and all sorts of otherwise inaccessable places. Another way is to stick it through backrests of couches, car seats, etc. They have to be burned as there is no way to remove the stench.

If you're going to a bar or theater and anticipate some loudmouthed slob, casually walk behind him and squirt some stench on his back. He'll be forced to leave.

Although hypos are the easiest and least noticeable way to deliver stenches, if your stench is worth using, the hypo won't block its odor for more than a few minutes. You'll need a vaccine bottle to carry it around in. These block all but the most volatile stenches such as Mercaptan. In this way, you can carry stenches or poisons

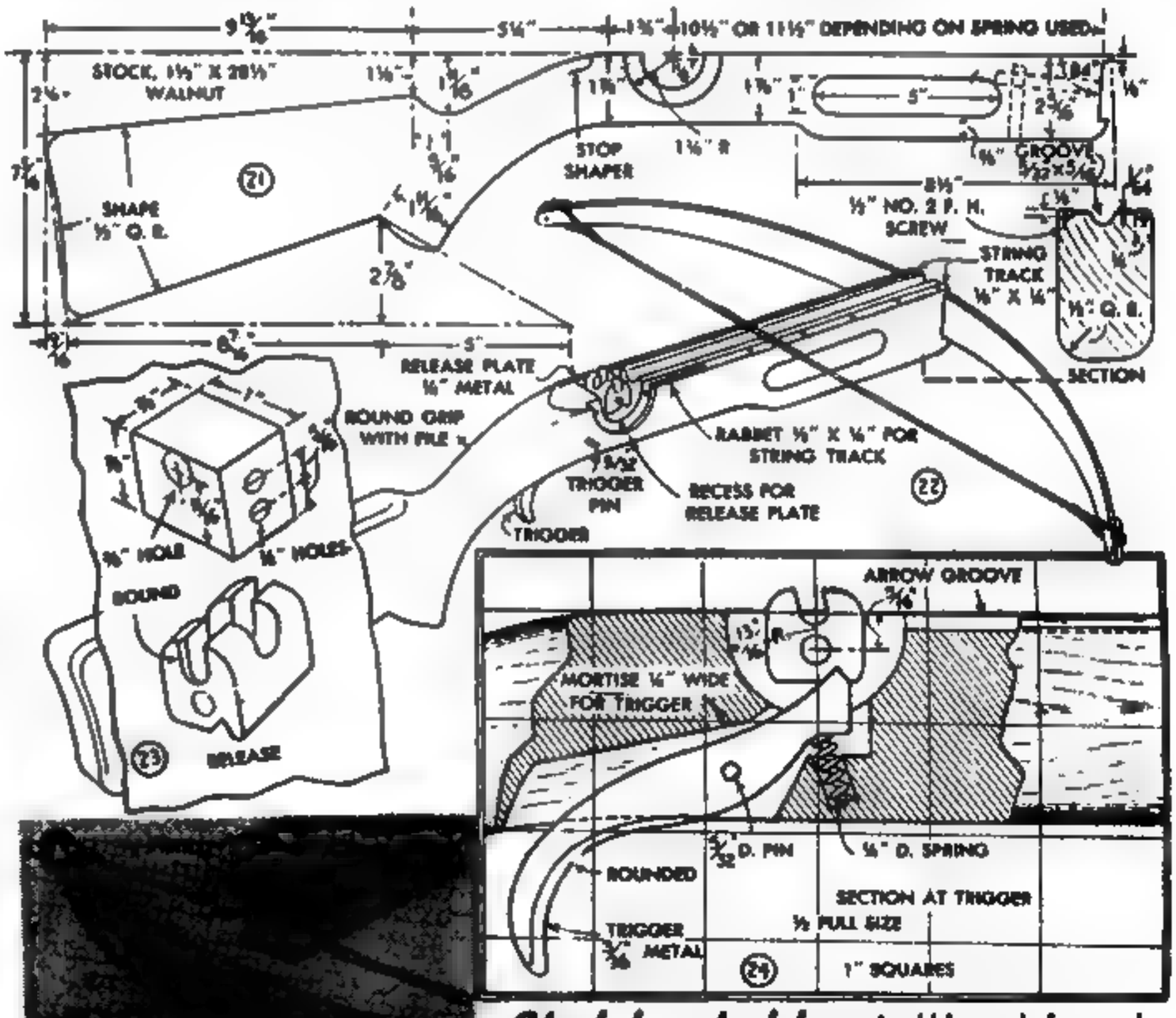


(20) 23-IN. SPRING-STEEL BOWS

Spring Thickness	Initial Set	Brace	Spring to Release	Pull and Threads to Hold		
				1" Wide	1¼" Wide	1½" Wide
1/8"	About 2¼"	3½"	11½"	42 lbs./12	52 lbs./12	63 lbs./12
9/64"	About 2¼"	3½"	11½"	60 lbs./12	75 lbs./16	90 lbs./18
5/32"	About 2¼"	3½"	11½"	83 lbs./16	104 lbs./20	126 lbs./24
3/16"	About 2¼"	3½"	11½"	142 lbs./28	179 lbs./36	216 lbs./42
7/32"	About 2"	3"	10½"	188 lbs./38	236 lbs./48	285 lbs./58
¼"	About 2"	3"	10½"	289 lbs./56	363 lbs./70	438 lbs./82

things considered, makes much the better crossbow. The spring stock can be obtained from a light automobile leaf spring. It will cost you two high-speed steel hacksaw blades to saw it to shape, Fig. 19. If the spring is a little wider than needed, it is a good idea to leave the extra metal intact at the center, as shown in Fig. 16. The bow tips are cut from sheet plastic, riveted in place and filed to take the string. The steel bow will have an initial fixed set of about 2-in. deflection, and should be braced at 3½-in. deflection as shown in Fig. 16. The table, Fig 20, shows approximately what leaf-spring steel will pull in pounds at 11½-in. draw. A 100 to 160-lb. bow is recommended. Extremely heavy bows over 300 lbs. drawing weight make nice exhibition pieces for flight or penetration shooting, but are no fun to shoot as you seldom retrieve the arrow intact if at all. It is practical, however, to make two or three bows of different weights, all interchangeable on the same stock.

Bow strings: Bow strings for wood bows can be purchased or made from 6-cord flax thread. This kind of thread is used in stitching machines by shoemakers. Twelve threads will hold wood bows to 80 lbs., the loop at the end being made by turning the whole string back on itself. The string for a 23-in. steel bow is made on a simple wooden form, as shown in Figs. 17 and 18. In this case, the string is divided into equal parts to make the loops. Both loops and a distance of 4 in. at center are wrapped, and the completed string is waxed with beeswax. The string can be shortened by giving it several twists before fitting to the bow. The triangular-boxed figures in table



Stock for steel bow should be made from walnut or other hardwood. The bow is housed in a notch cut in forward end. All parts of the action must be metal and carefully made and fitted so they will withstand the strong pressure of the steel bow

around safely and draw them out with the hypo just before use.

The Scientific American.
June 1861

Rifleman's Belt Rest.

A patent has been taken out in England lately by W. R. Taylor, of Oxford, for a peculiar construction of rifleman's belt, to be used as a rest when firing. A strong piece of india rubber is introduced into a part of the belt to render it elastic, and that part of it nearest the left elbow is made slightly wider, and has a small opening in it. When firing, the point of the left elbow rests in the opening of the belt, and the arm which supports the rifle thus exerts a downward strain upon the belt. This, the patentee states, prevents the muzzle being thrown up when the charge explodes, and also gives steadiness to the aim of the marksman.

DON'T BITE THE CARTRIDGE.

In the authorized version of U. S. Infantry Tactics, published by J. B. Lippincott & Co., Philadelphia, the following directions for handling cartridges are given on page 78 :

Take the cartridge in (not between) the thumb and first two fingers, and place the end of it in the teeth. Tear the end of the cartridge down to the powder, then hold it upright," &c.

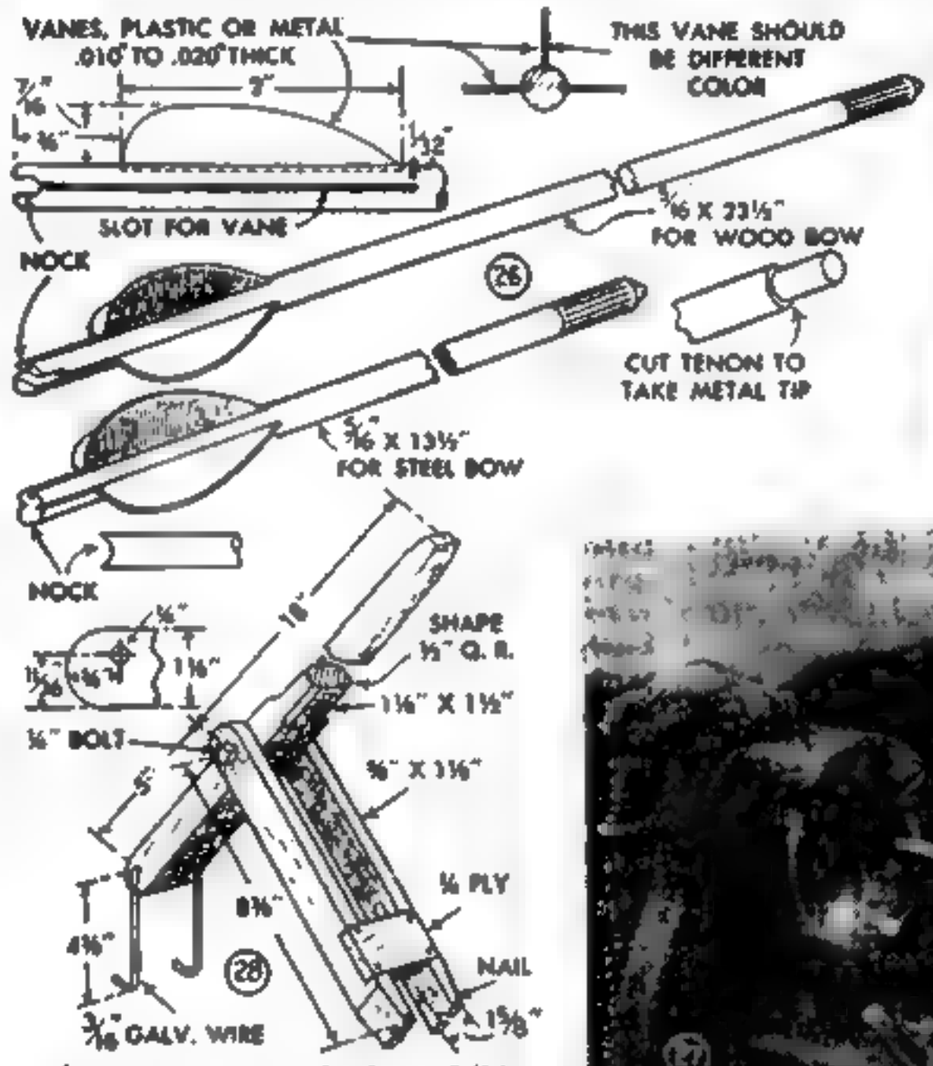
This is one of the multitudinous and unscientific movements still retained in our military tactics. A man may be young, sound in limb, strong of arm, quick of foot, keen of eye, and a first rate shot, but if he has had the misfortune to lose his front teeth by a kick or fall, the fellow, however patriotic, cannot be admitted into Uncle Sam's army, and all because he cannot bite the cartridge with his absent teeth.

It is well known to all soldiers that the tearing of cartridges with the teeth in battle soon causes an almost intolerable thirst. It is one of the least agreeable operations to a soldier to bite a cartridge, especially if it is lubricated with grease, and we are astonished that military men should still cling with such conservative leadenheadedness to the practice when a very superior mode is known. By filing the upper edge of the handle of a fixed bayonet until it is made quite sharp, the soldier, instead of being required to bite his cartridge, can rip it open neatly and rapidly, by drawing its end upon the edge of the bayonet handle. All the bayonets used in the army should be filed as suggested ; the expense would not be over one cent for each, while the improvement would be of incalculable value if introduced into the army.

Fig. 20 are the number of threads of 6-cord flax required to hold a bow of the drawing weight indicated. Stepping on the center of the bow while the ends are supported on wood blocks will bend the bow enough to permit slipping the string in place.

Stock for steel bow: Because of the heavier drawing weight, the stock for a steel bow must be made from walnut or other hard, strong wood. The stock should be laid out full-size, Figs. 21 and 24, then transferred to wood, cut out, and then machined in much the same manner as the wood-bow stock already described. An addition is the metal track on each side of forearm, Fig. 22. This originally was to protect the wood from the rubbing action of a metal bow string. The metal string (6-strand, 19-wire flexible cable 5/32-in. dia.) did not stand up under actual shooting and was discarded for the flax thread. The track, however, is worthwhile protection even with the flax string, although not essential. All parts of the action are metal, steel for the release, Fig. 23, and trigger, and aluminum or brass for release plates and string track. The bow is housed in a notch cut in the end of the stock, and is held by means of three locating pins and a bolt, as shown in Fig. 25. The carriage bolt is ground round under the head, which is sawed to form a screwdriver slot. The release pin is ¼-in. diameter, slotted on one end for a screwdriver and threaded on other end to fit a tapped hole in the release plate. All metal parts are of ample strength for bows up to 400 lbs. drawing weight. Follow the release and trigger design closely; these parts are nicely balanced to provide positive holding while retaining a light trigger pull.

Arrows: Arrows for both bows are 5/16-in. birch dowel. Vanes are plastic, celluloid or metal, glued in grooves cut in the shaft.



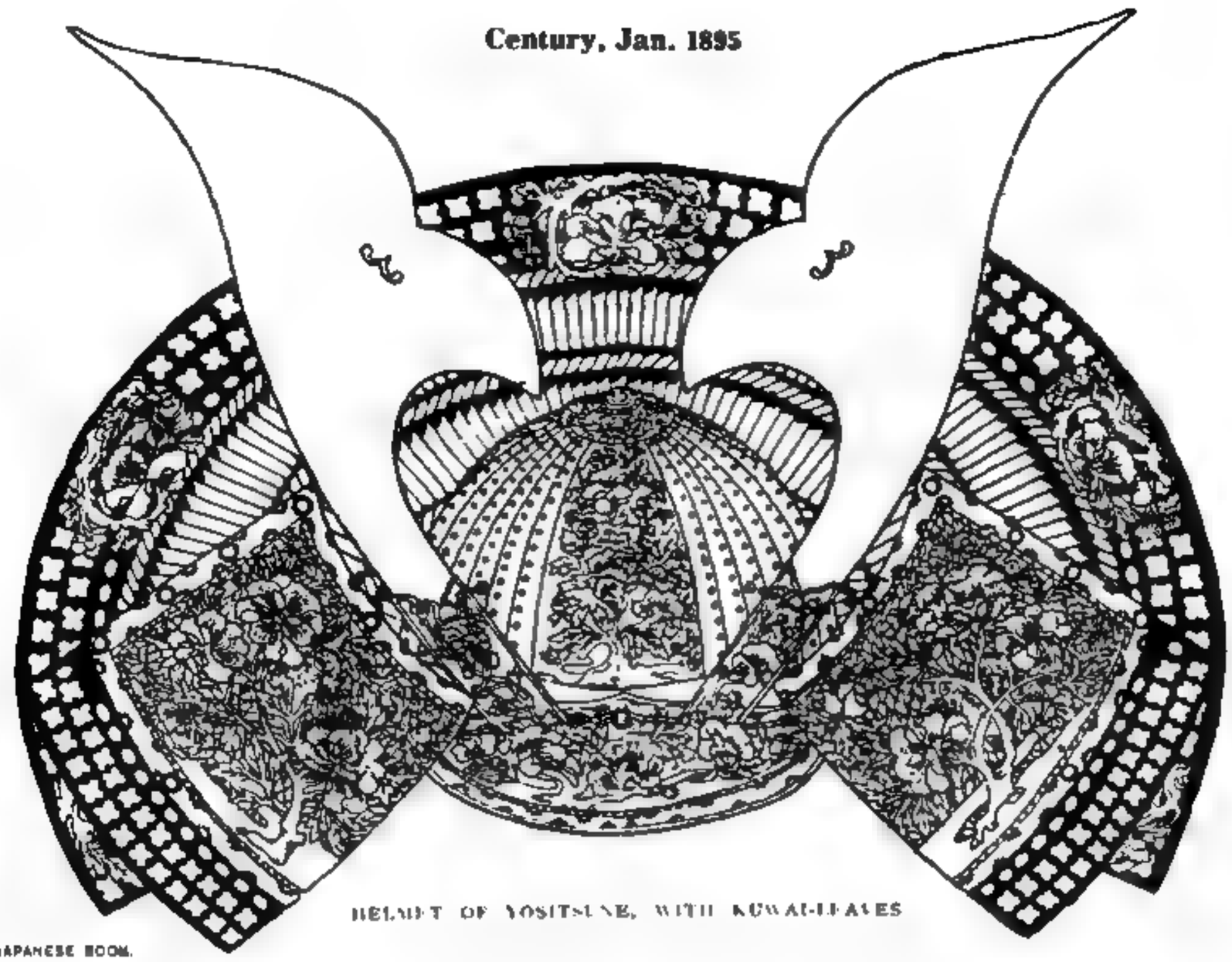
Arrows are made from 5/16-inch birch dowel. The vanes are cut from celluloid and are fitted in the grooves cut in the shaft

Fig. 27 shows one way of cutting the grooves, the shaft being held in the lathe, positioned by the indexing head, while a rotary hand tool mounted in a slide rest does the cutting. Vanes are mounted at right angles, Fig. 26, instead of the usual triangular pattern used for long bow arrows. This method of mounting provides perfect ruddering for smooth, straight flight and, at the same time, fits the mechanical construction of the crossbow.

Cocking lever: Bows up to about 100 lbs. drawing weight can be set by hand; over this weight it is necessary to use a cocking lever. Fig. 28 shows the construction and dimensions of a cocking lever for 11½-in. draw. The galvanized-wire hook which slips under the bow will automatically assume a bent position the first time it is used. Photo Fig. 7 shows the manner of using the lever. If the release is set slightly forward, the trigger will cock automatically when the string engages the rear prong of the release.

Shooting: After cocking the bow, the cross bow is shot very much like a shotgun, sighting down the arrow to the target. A little practice will enable you to judge the range and drop of an arrow very nicely When hunting, the bow can be carried cocked but without arrow. When not in use, the steel bow is left braced, but the wood bow is unstrung. Needless to say, any bow over 100 lbs. packs a terrific drive, and the utmost caution should be exercised in its use. Never fit an arrow in place until you are ready to shoot, and don't point the gun in any other direction than toward the target when the arrow is in place.

Century, Jan. 1895



HELMET OF YOSITSUNE, WITH KUWAGATA LEAVES

FROM AN OLD JAPANESE BOOK.

THE ARMOR OF OLD JAPAN.

With illustrations from "Precious Jewel Records of Military Usage," Japan, 1694.

HELMET OF YOSITSUNÉ, WITH "SKY-PIERCER"
1183 A. D.

OF the art of Japan, as shown in the wonderful warimplements of her great military leaders of old, the daimios, and of their vassals, the samurai, few of us have any but the vaguest of knowledge. A few suits of curious armor in the museums of our large cities, a few swords,—the long one for despatching one's enemies, the short one for despatching one's self, according to the code of honor among the Japanese,—give us the merest hint of the admirable defenses and weapons which were produced by this energetic and intellectual race during ages of warfare.

In Memorial Hall in Fairmount Park, Philadelphia, is a small but very interesting collection of the weapons and armor of old Japan. These wars lasted until three hundred years ago, when the long peace set in. To this peace we are indebted, perhaps, for the best of the art we now enjoy, except in this one branch—metal-work. For this, warfare was the great stimulus, and the metal-worker of twelve hundred years ago, in the opinion of so good a judge as Anderson, "had little to learn in mastery of materials or tools."

The collection was brought to this country a few years ago by Tatsui Baba, a young samurai belonging to the patriotic party, and well known throughout Japan as an able writer and a leader in public affairs. He had made a special study of the ancient armor of his native land. The results of his researches he gave in the form of lectures before the learned societies of our large cities. After his death in 1888 his cherished curios were secured by the Pennsylvania Museum and School of Industrial Art, whose collections are housed in Memorial Hall.

The most striking things to a casual observer are the three curious suits of war-harness, examples of that worn in Japan during the third,[1] fourteenth, and sixteenth centuries. This must not be classed with the armor we see in almost every curiosity-shop abroad, which is of much later date, belonging in many cases to a soldier of our own day.

As with other nations, the war-harness of rawhide, called in Japan "shell" ar-

BATON.

DRAWN BY OTTO H. BACHER.

mor, came first, and lasted down into the ninth century. This was the time of Charlemagne and his leather-clad knights, when, in Europe, "every man wished two things: first, not to be killed, and, next, to have a good leathern coat." Tunics were of plaited leather; and coats, hoods, breeches, and shoes were made almost entirely of this material; and while the coats, it is true, had plates of iron riveted upon them, the casques alone were of steel.

DRAWN BY OTTO H. BACHER, FROM A SPECIMEN IN MEMORIAL HALL, PHILADELPHIA.

THIRD-CENTURY ARMOR.

The iron-and-lacquer war-harness of Prince Shotoku, the great apostle of Buddhism, may still be seen in the old temple of Horiuji in the province of Yamato. It was worn about 586 A. D., and is the earliest specimen of Japanese armor in the possession of the nation. A picture of the prince in his elaborate court dress, drawn by himself, as the Japanese declare, is kept in the temple of Tennoji in Osaka, along with his "sword of seven stars." On the blade of this sword shine the seven stars which rule human destiny, and the dragon, symbol of his mission as defender of the faith of Buddha. It was to his neighbors the Koreans, most likely, that Prince Shotoku owed his fine war dress; for their craftsmen came over the sea to Japan during his time, bringing with them a knowledge of metals and of art superior at the time to that of the islanders. Indeed, the Japanese of the present day prefer to their own truly artistic work their heirlooms of old Korean and Chinese make, which in our eyes are often far from beautiful.

Of the three suits of armor in Memorial Hall that attributed to the third century is the most richly decorated. A description of this suit will answer, with few exceptions, for all three; for in that fortunate land the fashions did not change, but descended unaltered for generations from soldier-father to soldier-son.

FROM A SPECIMEN IN MEMORIAL HALL, PHILADELPHIA.

The cuirass is called the "breast-binder," and is made of leather, on which are fastened thin plates of well-tempered steel covered with polished black lacquer. The lower edge of one row of plates is covered by the upper edge of the row beneath, in window-shutter fashion. The little plates are fastened together with stout silk braid in several shades of purple. There is such a profusion of this braid that it gives a decided hue, and a name, to the whole suit. The Mikado himself, should he appear on the field of battle, would wear the "armor of shaded purple," and his bow-gloves would be dyed in the same royal color. To this cuirass are fastened the half-dozen separate tassets which hang from the waist nearly to the knees. They are made, like the cuirass, of narrow, upright steel plates bound together with the same purple braid. Underneath them is worn a sort of divided skirt of yellow brocade, stout and heavy, and on this are fastened the two pieces of plate-armor which guard the lower thighs.

The sleeves are of the same strong yellow brocade, covered partly with chain-armor, partly with plates of iron overlaid with brass. The brass is openwork, with a charming design of plum-blossoms, the round elbow-guards being specially attractive.

The war-chief who owned the original of this harness fought on horseback, for his long leg-guards are entirely of iron, carefully modeled to the shapely leg of the wearer, and covered with brilliant black lacquer. Gilded butterfly-clasps join the three upright strips, ten butterflies in all, and every one different. For his retainers, the fighting footmen, locomotion was made easy by having side-pieces of pliant leather set into their leg-guards.

The iron helmet, studded closely with little iron points, is a fine piece of workmanship. The brazen horns stand bravely up in front, looking, with their central ornament, like a pitchfork or a trident. The broad iron flaps which

[1] So attributed, but probably belonging to the sixth or seventh century.

turn back to guard the temples are covered with leather dyed in plum-blossom pattern, and have on them the badge of the chief, a single kiri-leaf. The daimio, though king of his own domain, must never dare to assume the triple kiri-leaf, a symbol forbidden to all but the Mikado himself.

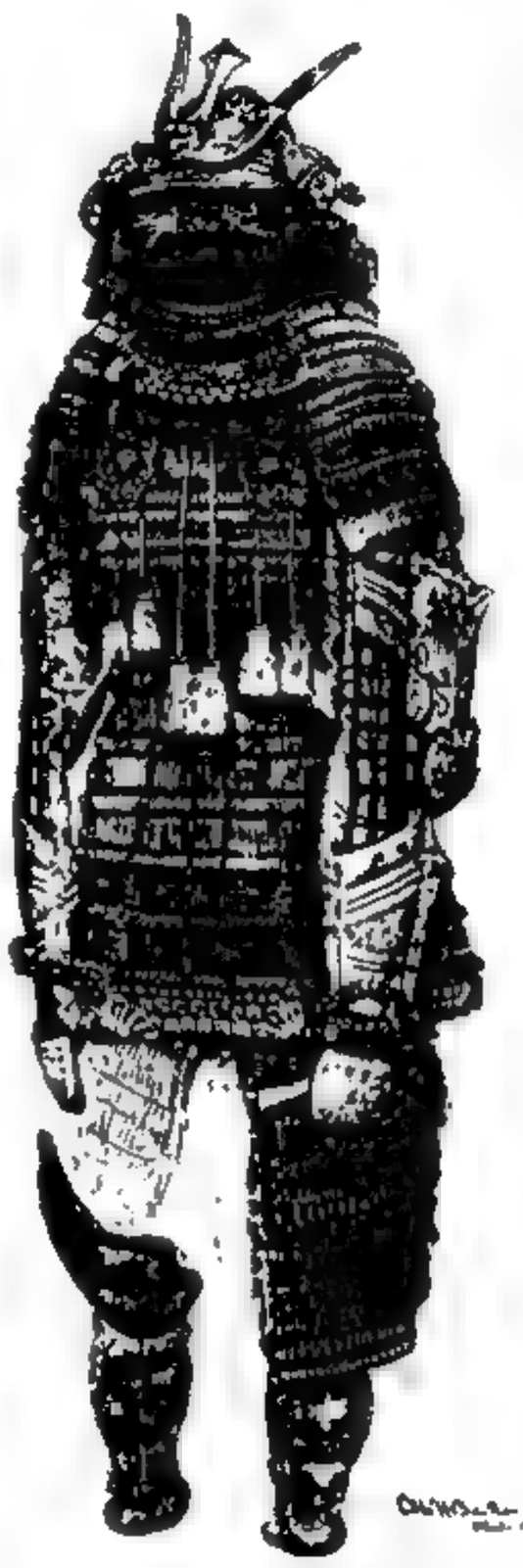
In the iron face-guard, nose, chin, and ears all come in for the kindly consideration of the modeler. The mouth and nostrils have shapely breathing-holes, while underneath the chin is a row of little "ventilators." Such charming devices for comfort were unconsidered and unknown among the European armorers of that early time. To make all secure, throat and neck were covered with a sort of beard of plates hanging down from the face-guard. Even the very oldest helmets have an air-hole at the top, usually forming the center of a silver chrysanthemum. The ancient Japanese metal-workers, with their race passion for decoration, turned even a ventilator into a thing of beauty.

The daimios of those old times had three favorite ornaments for their helmet-fronts, and seldom cared to vary them. The one most familiar to us in art was two huge leaves of a very decorative Japanese water-plant, the kuwai. These, made of chased brass, and often covered with silver and gold, stood up in front of the helmet, one turning to the right, the other to the left. Next in favor came the "sky-piercer," much like the first except that the two kuwai-leaves scraped the sky even more defiantly. The third was the crescent. The horns (representing courage) in the early armor we have just described were also in high repute among the chiefs.

In later days the smiths used their ingenuity in inventing every kind of curious and grotesque helmet shape and adornment, bringing into service all manner of queer shells and fishes, birds and beasts, monsters and devils. Waving tongues of flame, skilfully reproduced in metal, often glistened over the heads of the great commanders.

The twelfth-century armor of Yositsuné, Japan's most famous hero, is carefully guarded in the Temple of Rising Happiness (Kofuku-ji) in the ancient town of Nara. His helmet is there, with chasings of silver and gold, with flaring kuwai-leaf plume and so-called "lion" crest. The Japanese had probably never seen a lion with their own eyes; they used the eyes of the Chinese, and between the two pairs of oblique orbs the king of beasts became a pitiable distortion. The Japanese name for this conglomerate is "foreign lion." On the breast-plate three of the same extraordinary beasts, with tufts on their tails and rosettes on their legs (like the prevailing fashion in black poodles), are snarling at one another among the imperial gold and silver chrysanthemums.

There was a special decree as to the manner in which the warrior of these middle centuries should put on his elaborate armor: a sequence modeled after the fashion or fancy of no less a personage than Yosi-iyé, head of the Minamoto family in 1057.



DRAWN BY OTTO H. BACHER, FROM A SPECIMEN IN MEMORIAL HALL, PHILADELPHIA.

FOURTEENTH-CENTURY ARMOR.

Right leg left without the armor-guard to show shape of piece for lower leg.

First he must swathe himself in a long and voluminous garment of yellow cotton, and a pair of equally voluminous white cotton trousers. His long hair, to keep it out of his eyes, should then be tucked up under a peaked cap of leather, which saved the head from the helmet's pressure. Next he must strap on his bow-gloves. After that came a second coat and trousers, a sort of undress uniform, preparatory to the armor proper; then the leg-guards, the bearskin shoes, and the sleeves of mail. Lastly, the suit of armor, with its helmet, was tightened on with the long silken rolls or tubes that answer to our leather straps; the final touches, in the shape of sword and dagger, "arrow-cage" and arrows, bow and banner, were added — with groans, one would fancy; and this strange warrior was ready to strike terror into the souls of the enemy.

A set of colored prints from Japan shows the daimio in process of putting on these articles, each in its proper order. The attitudes are striking, one in particular, after he has put on his clumsy bow-gloves, and is struggling to tie his bearskin shoes. Of these shoes there is a pair in the collection, with black leather soles stamped with chrysanthemums, and black bearskin uppers with the shaggy hair outside, a shapeless but comfortable foot-gear. The ancient buckskin bow-gloves, too, are here, consisting chiefly of a very fat wadded thumb and two fingers for the right hand and a solitary thumb for the left.

The obvious awkwardness of the order in which these warriors of the middle ages were forced to array themselves was probably due

merely to the personal fancy of a great leader like Yosi-iye, but was copied so faithfully by his conservative followers that the tradition, after lasting simply as a tradition for nearly three hundred years, crystallized in 1331 into an actual code.

The fourteenth-century armor in the museum is much plainer than the suit just described. It has the "round" cuirass, the whole effect of which is red, owing to the profusion of red silk braid used for binding the plates together. The old Japanese braid was not like most of ours, half cotton or linen: it was pure silk, of the toughest and most enduring character, plaited in a way which secured the highest degree of resistance. The Japanese much preferred it, for most uses, to thongs of leather.

The daimio who wore the original of this armor had a fancy for a crescent between the two great water-leaves of his helmet, and a weakness for his chosen device or ancestral crest, which is on every part of the suit where a device could possibly be placed — on cuirass, hand-guards, thigh-guards, and, above all, on his helmet, where it appears on the little upright ears that take the place of the temple-flaps, and also on the front of the helmet, below an archaic Japanese character meaning "warrior" or "military man." This badge or device is the Buddhist symbol for ten thousand.

The ordinary wooden bucket of Japan gives name and shape to the "bucket" cuirass of the sixteenth-century armor. Its helmet shows the later and rather startling taste of the armorers or their masters. Instead of the brazen spade, crescent, or water-leaf, simple and decorative, that had shone for centuries over the heads of the daimios, they must now make themselves frightful with monsters. Here we have the grinning head of a devil, with glass eyes and great hooked teeth, pointed ears, and long, curving, gilded horns. Flowing locks of gray horsehair stream down on each side of this grisly countenance, and a huge gray horsehair mop takes the place of the fine old lion or dragon crest of the earlier chiefs.

The heart of the modern devotee of "high art" in fabrics would be gladdened by the design of the heavy brocade on which the iron defenses for the sleeves and lower thighs of this sixteenth-century armor are fastened; where, through a background of softest gray-and-silver clouds, the imperial dragon is drawing the coils of its vaporous body. The same stiff brocade forms part of the side-piece of the work of art with which the armorer protected the legs of his feudal lord, the original owner of this suit. The leg-guard is, as always, of lacquered iron, but its lower side-piece is of stout buckskin dyed in brown, leaving in white a few dragon-flies scattered over the surface. The wadded knee-piece is of snowy buckskin quilted in hexagons, each with a "cross-knot" of red silk braid in the center.

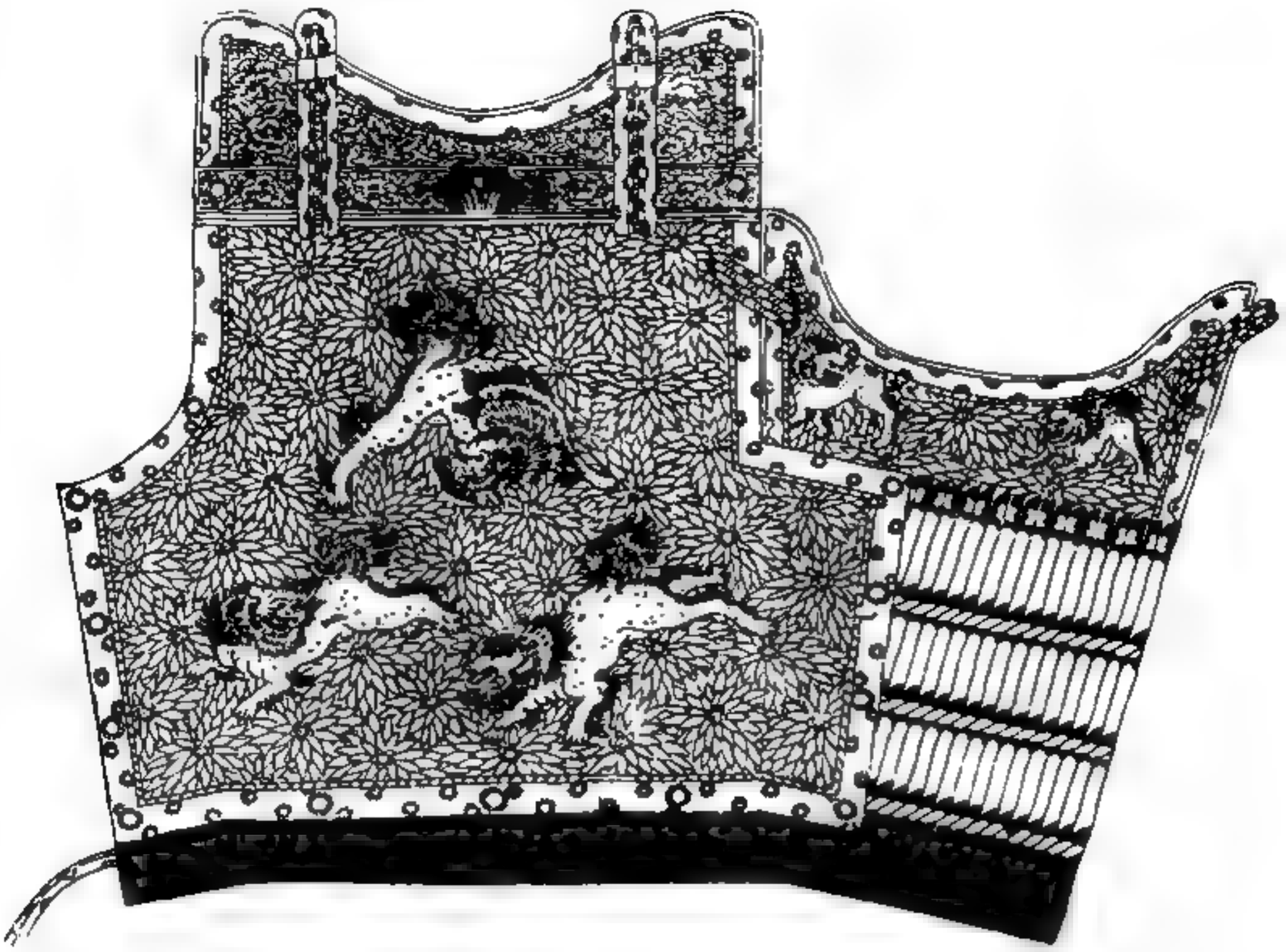
By the side of these, though not in the same collection, is a suit of armor worn about three hundred years ago by the Prince of Tchui. It was selected by the governor of Kioto for a recent American consul, as a fine specimen of the old lacquer-work. The cuirass is lacquered both inside and out, the outside being solidly gilt. The helmet-crest is a red disk, upon which one may dimly discern a golden lotus-blossom.

The small silken flag or banner on which the ancestral blazon or the device chosen by the warrior himself was painted, embroidered, or woven, was often carried on his own back. This strikes one as an economical and clever arrangement: it saved the banner-bearer's daily wage of rice, and one's colors were always on the spot at the critical moment. The daimio of those stirring days was entirely independent in this respect: his banner-staff was slipped through a hinged eye at the top of his cuirass-back, its pointed end fitting into a socket at the waist. Two of the suits of armor brought from Japan by Tatsui Baba have this eye-and-socket arrangement.

The blazon, like those of the knights of other nations, was chosen to keep in remembrance some feat of arms performed by the warrior. Should he be so happy as with some favorite "cut" to slice off the heads of three of his enemies in battle, he would be apt to choose for a family coat the three severed heads. We can fancy him, armed cap-a-pie, urging his small, shaggy charger into the fray, with the triple-headed banner waving over his shoulder.

Other emblems worn in the same way were made in the shape of fans and temple-bells, butterflies and stag-horns, as in the head-piece.

From the twelfth to the seventeenth centuries the fighting was frequent and fierce, and the



FROM AN OLD JAPANESE BOOK.
BREASTPLATE OF YOSITSUNÉ, WITH THE IMPERIAL LIONS AND CHRYSANTHEMUMS. 1185 A. D.

armor more protective. Out of the "three articles"—helmet, breastplate, and sleeves—which we read of in the ancient Japanese records had been gradually evolved the "six articles": a metal covering for face, legs, and thighs gave a man a better chance for his life against the rapid cuts of those wonderful blades, or the quick spear-thrusts delivered by the short but sturdy knights and their retainers. The more we study this armor the more admirably does it seem adapted for a defense against the special weapons opposed to it. These were seldom the heavy hammers and great crushing battle-axes of the Europeans, or, later, their bolts and bullets. They were chiefly arrows, spears, and halberds, swords and daggers; but these were unrivaled in metal and make, and were wielded with extraordinary skill.

The Japanese armorers, from the earliest centuries, united in their war-harness such flexibility and lightness, efficiency and comfort, together with beauty of workmanship and decoration, as were rare among their craft in Europe. Using the invaluable and universal leather as a foundation, they covered it, as did the Europeans, with plates of iron or steel.

But instead of compelling their lord and his retainers to waste time and strength in keeping their war-gear rust-free and glistening, they simply covered these plates with their wonderful lacquer. Lacquer added little weight to the metal plates beneath it; no burnishing was needed upon its glossy surface, the rounded form of which often served to turn the enemy's sharpest arrow or keenest sword-blade. Above all, the destroying devil of rust was annihilated. According to the old chronicles of the knights of Europe, as much muscular force was wasted in furbishing up their armor as would have beaten the enemy twice over.

To illustrate the conservatism of the Japanese in their armor, we quote a native account of a fight which occurred in the streets of the capital Kioto as late as 1864, between the troops of the shogun, who had possession of the person of the emperor, and the forces of the "irregulars," who were clamoring for the expulsion of all foreigners.

The Choshiu troops [irregulars] were defended by armor, their leader clad in a suit of armor tied with grass-green silken strings, and covered with a garment of Yamato brocade. Over this he wore a surcoat of white gauze, with figures drawn on it in black. He bestrode a charger, a baton of gold paper in his hand. Before him went flags and banners and two field-pieces, with a company of thirty spearmen. The spears, crossing each other, looked like a hedge of bamboo-grass; bullets flew overhead like axletrees. Helmets and cuirasses that had been cast away by their owners, spears, pikes, bows, and muskets, were lying about in quantities.

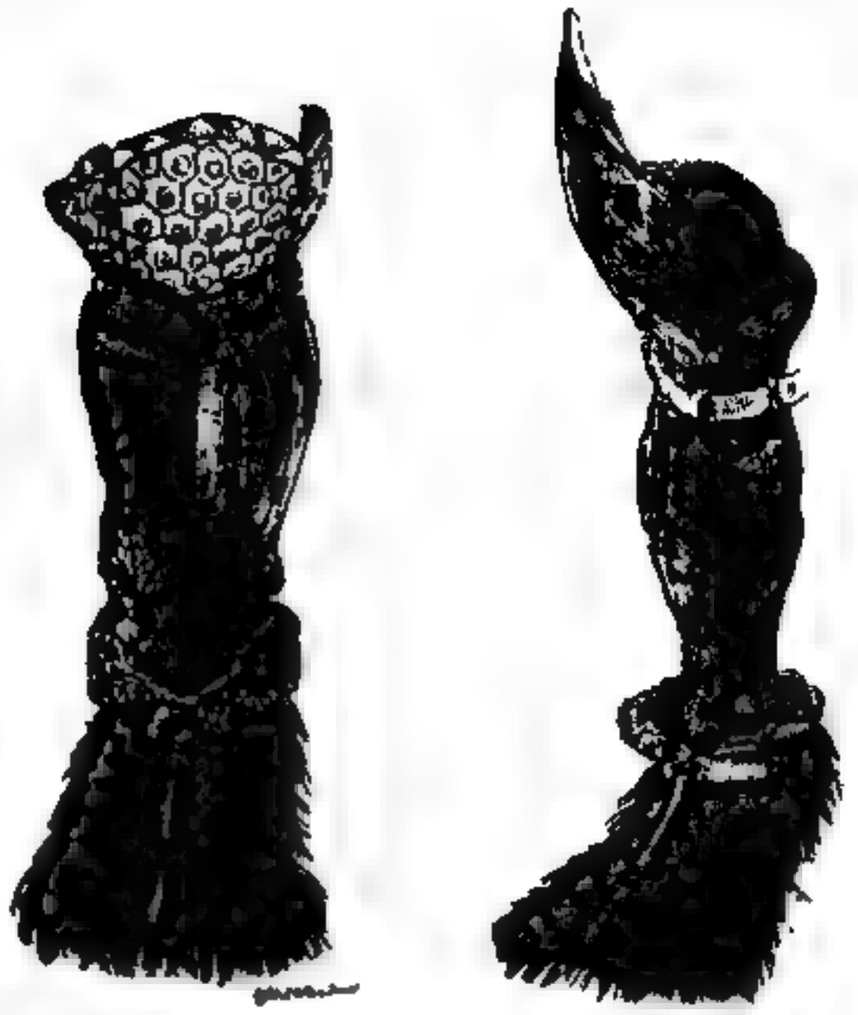
Another leader was

DRAWN BY OTTO H. BACHER, FROM A SPECIMEN IN MEMORIAL HALL, PHILADELPHIA.
SIXTEENTH-CENTURY ARMOR.

mounted on horseback, and held a baton of white paper in his hand. He wore a mantle of scarlet embroidered with his crest, the trefoil, and under it a suit of armor adorned with purple fastenings. His head-covering was a warrior's cap of bronzed leather.

These batons, a very early symbol of authority in Japan, were wielded with vigor by the daimios. The one in this collection is a short wooden rod or wand covered with black lacquer and mounted in silver. At one end is a huge plume of the tough Japanese paper, silvered; and at the other, cord and tassels of heavy red silk braid. When not waving wildly in command, it hung by its cord to a ring on the breastplate.

The daimio, with his Tatar cockade and his overbearing ways, is now perhaps picking tea or binding rice. The samurai, with his two swords and his swagger, taxes the country no more. The beautiful swords have degenerated into curios. The modern army of Japan, modeled on European lines, equipped with the latest European firearms, admirably organized and disciplined, owes, nevertheless, much of its brave spirit to its iron-and-lacquer warriors of centuries ago.

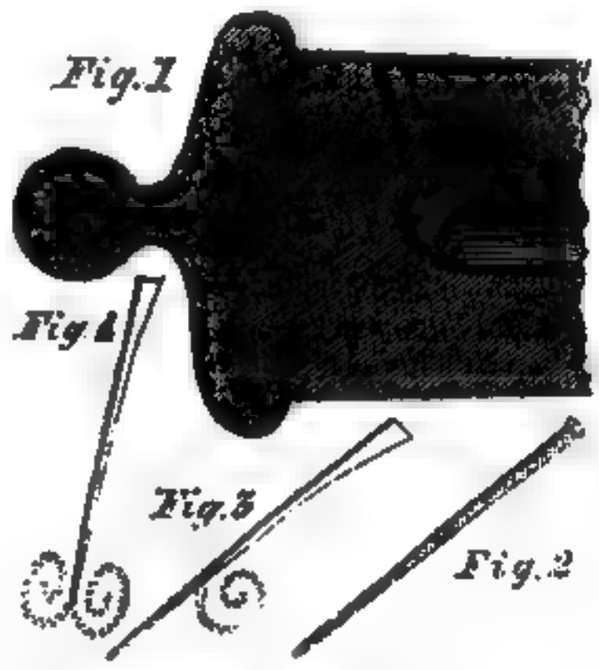


DRAWN BY OTTO H. BACHER, FROM SPECIMENS IN MEMORIAL HALL, PHILADELPHIA.
Sixteenth Century. Fourteenth Century.
LEG-ARMOR WITH BEARSKIN SHOE.

M. S. Hunter.

Mode of Spiking Cannon.
The Scientific American — June 19, 1861

From the number of inquiries which which have been put to us since Colonel Anderson spiked the cannon at Charleston, as to the way "spiking" is done, we are led to believe that a large majority of persons are ignorant of the process. To enlighten such, we have had the annexed views engraved to illustrate the plans most usually adopted. Fig. 1



represents a longitudinal section of a cannon, with its priming hole spiked with a small rat-tail file, as shown in Fig. 2. The steel is driven hard down, as far as it can go, and then broken off even with the surface of the barrel. The steel is so hard that it cannot be drilled, and so rough that it cannot be forced out, and is, therefore, the best material used. Figs. 3 and 4 show two forms of wrought iron spikes, which assume the position shown by the dotted lines when used, and thus cannot be withdrawn without much difficulty.

These three weapons must have been proved out by prototype as well as theory. What became of them? Does anybody know for sure?

ELECTRIC MACHINE GUN IS SILENT

Electric antiaircraft machine gun. Electromagnets hurl bullets

ELECTRICITY replaces gunpowder in a silent, smokeless, machine gun recently perfected for defense against hostile aircraft. Without betraying its location, this weapon is declared capable of firing 150 bullets or high-explosive shells a minute. Projectiles are hurled from its muzzle by a series of electromagnets spaced along the barrel, which start the missile moving and successively raise its velocity as they become energized.

Popular Science Monthly — September 1936

"KICKLESS" MYSTERY GUN IS TESTED BY ARMY

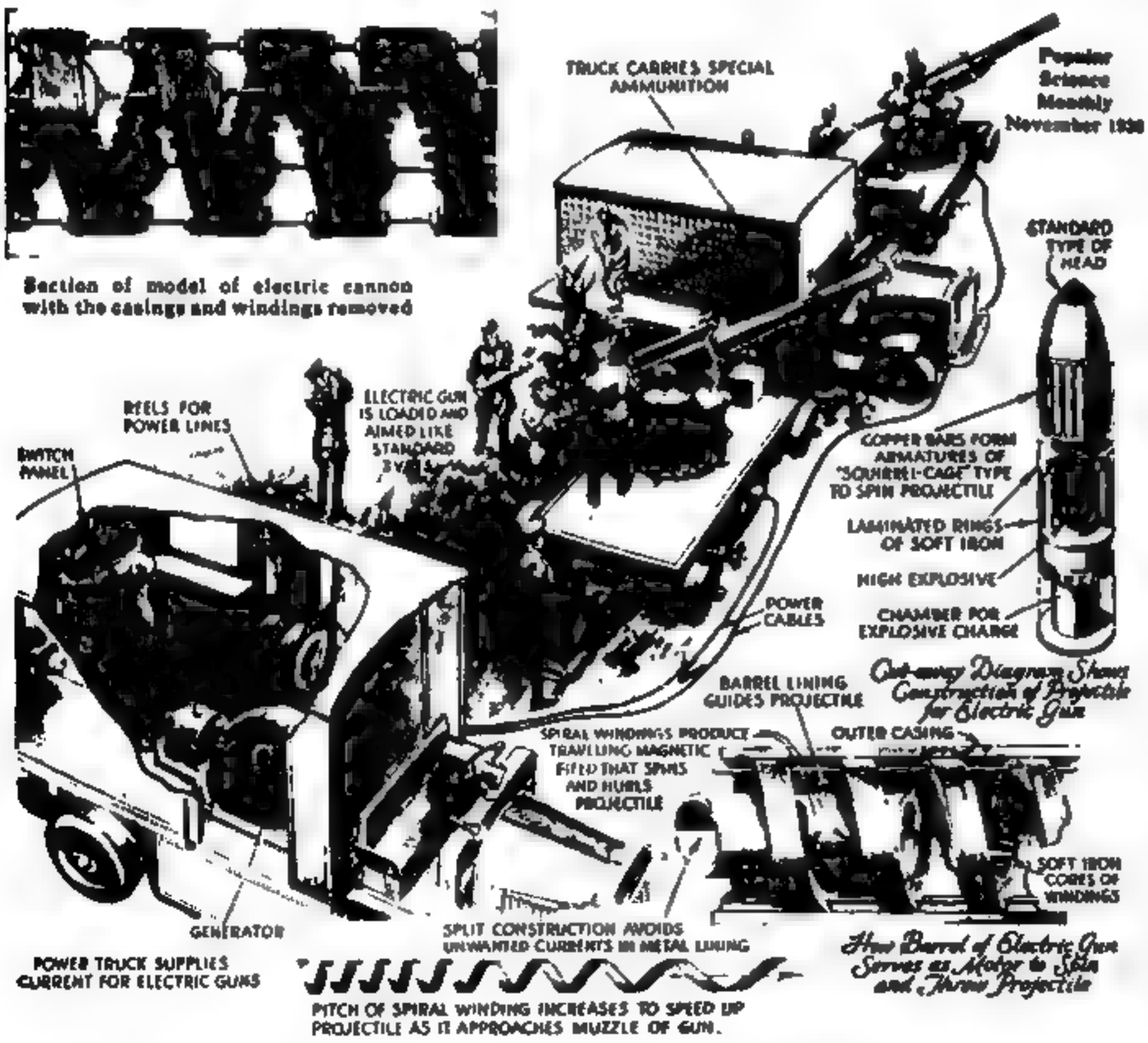
A NEW "kickless" mystery gun undergoing Army and Navy tests is reported to hurl one-pound, high-explosive shells at the rate of 150 a minute. Recoil is so slight, it is said, that water will not spill from a glass balanced on the barrel during fire. Each shell contains a charge powerful enough to shatter an armored tank or to demolish the wing of a heavy bombing airplane.

This gun is said to hurl 150 one-pound shells a minute, with little recoil

Popular Science Monthly May 1936

Silent Cannon Hurls Shells by Electricity

Section of model of electric cannon with the casings and windings removed

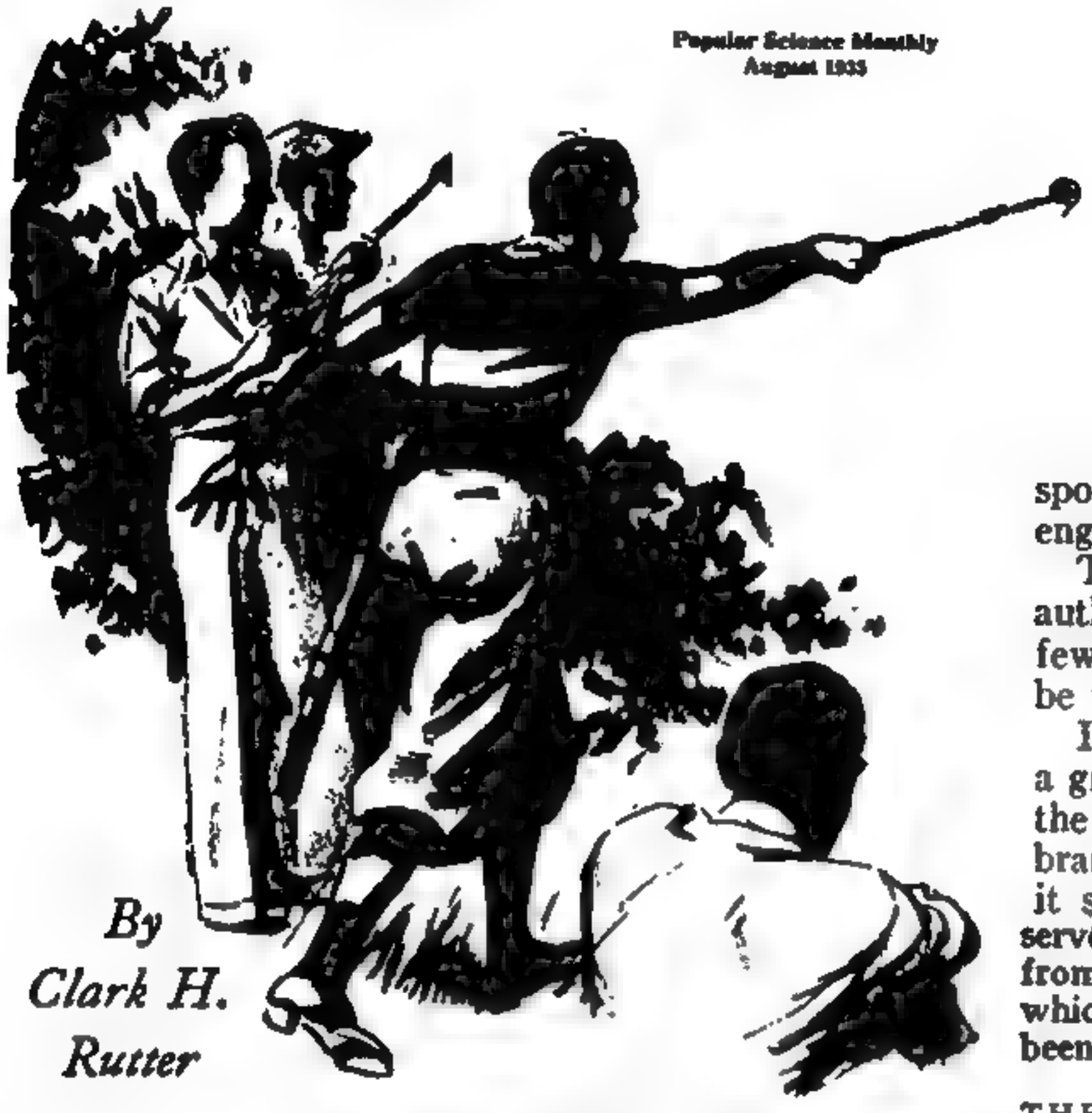


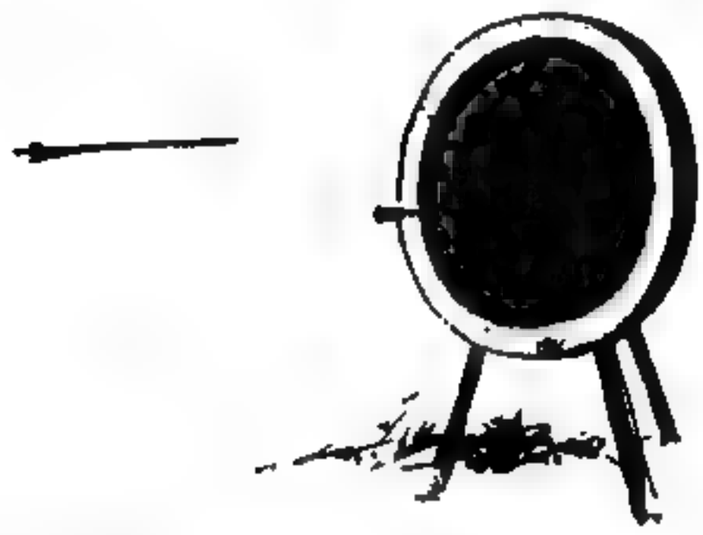
Popular Science Monthly November 1936

WHEN a switch is thrown, a projectile whizzes silently from an electric cannon proposed by a Trenton, N. J., inventor. No sound or smoke betrays the location of the gun, for it dispenses entirely with powder to fire its shells.

Cannon and projectile together constitute a veritable electric motor. When current is applied to the barrel, field coils become energized and the projectile, with a built-in armature, begins to rotate. By shifting the magnetic field lengthwise along the gun, the projectile simultaneously is given an accelerating forward motion. Thus it obtains both the muzzle velocity and the spin required for accurate flight without recourse to a propelling charge or to rifling in the barrel lining. A crude twenty-foot model of his gun, according to the inventor, hurled a homemade projectile—the rotating part of an electric fan—as far as 1,000 feet.

Practical electric guns, the inventor declares, could be built in any standard size and would have a range equaling or surpassing that of conventional artillery. Mobile generating field equipment would accompany the guns and supply the current, as illustrated in the picture at the left.





By Clark H. Rutter

TARGET PRACTICE WITH

Mayan Throwing Sticks

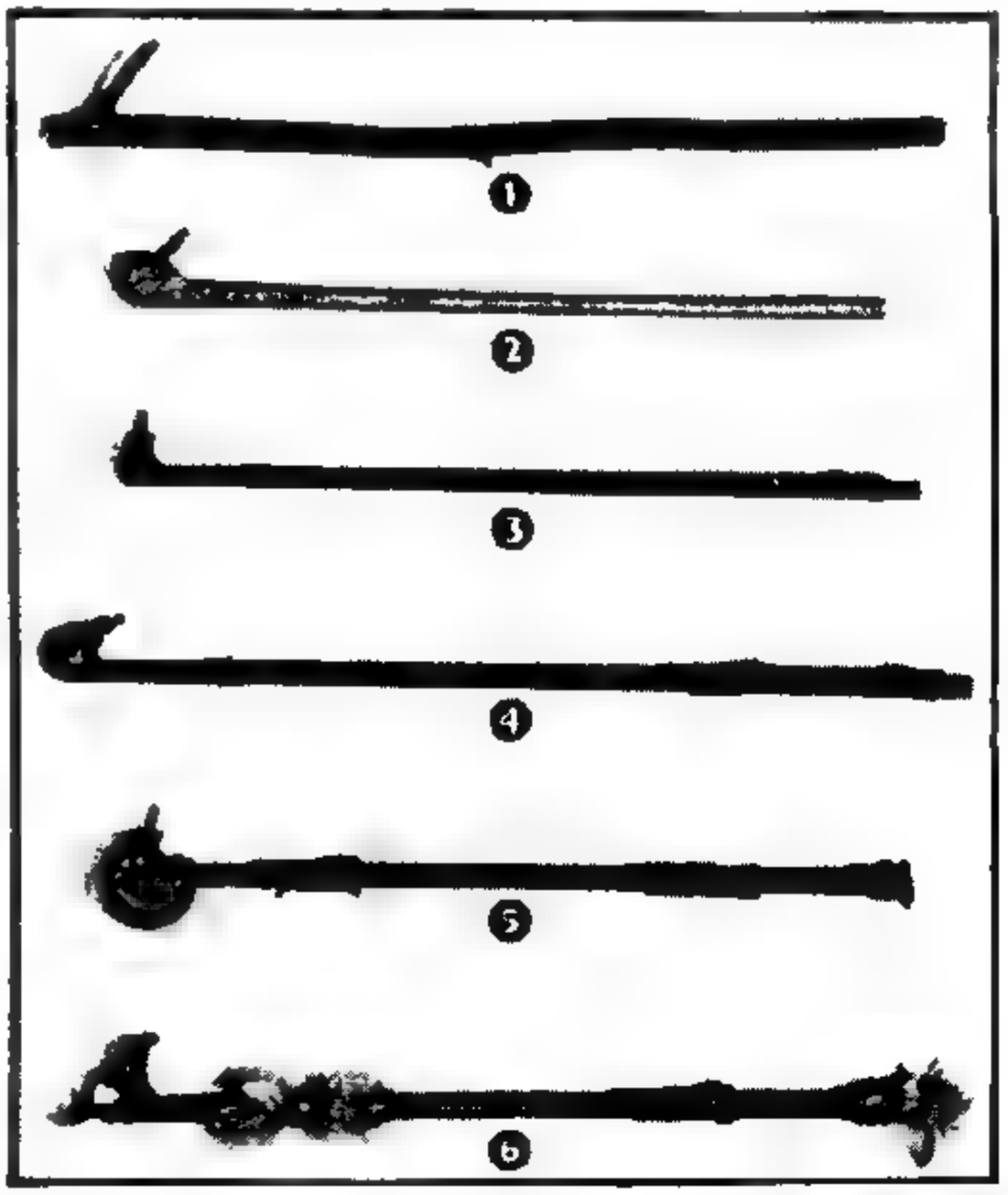
How to make equipment for a novel outdoor sport . . . Arrows are hurled with the aid of a curious ancient weapon instead of being shot

HERE is a fascinating sport that requires little equipment and is quickly mastered—hurling arrows at a target with a homemade hul-che, or Indian throwing stick.

The hul-che was one of the weapons used by the ancient Mayas in Yucatan and other parts of Mexico and Central America. It is merely a stick with a protruding head or peg, which engages the end of an arrow. By means of the stick, the arrow can be thrown great distances with surprising force and accuracy. Unlimited skill may be gained by practice; the exercise is a healthful one; and the sport becomes highly competitive when engaged in by a group.

The sticks illustrated are not copies of authentic Mayan designs, but represent a few of the many types that may easily be fashioned.

In the photograph below, showing a group of six sticks, No. 1 is made from the forked limb of a tree. The smaller branch is burned off to harden and round it so that it serves as a peg. The second stick is whittled from white pine, and the peg is a wood screw, which is rounded with a file after the head has been cut off. Slightly more elaborate is No. 3.

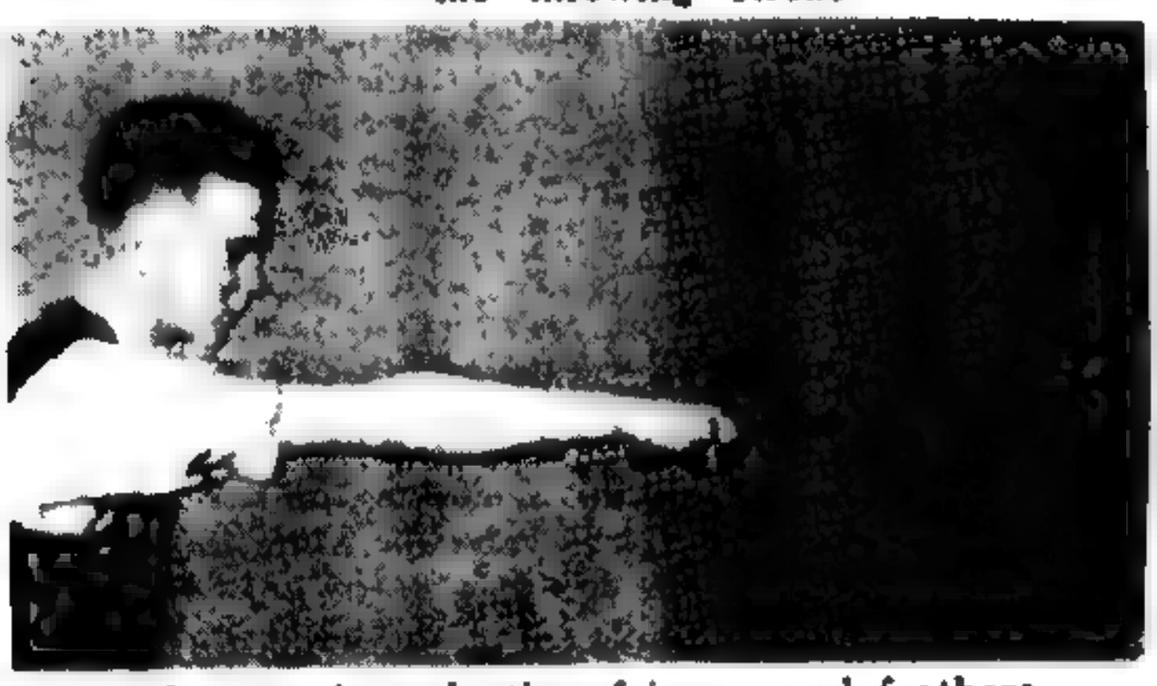


THROWING STICKS Six suggested designs. Lengths may vary from 20 to 27 in., and the pegs can be set at any angle from 45 to 80 deg. The first is merely a branch of a tree; the second and third are almost as simple; but the remaining three are carefully made.

It has an ebony peg, and there is a dowel pin through the handle for a finger rest. Cord is wrapped around the stick in two places for decoration.

Still better are the sticks marked Nos. 4, 5, and 6. These are made of maple and have turned ebony, bone, or maple pegs. They are painted in various colors and decorated with

Beginning and end of the throwing stroke

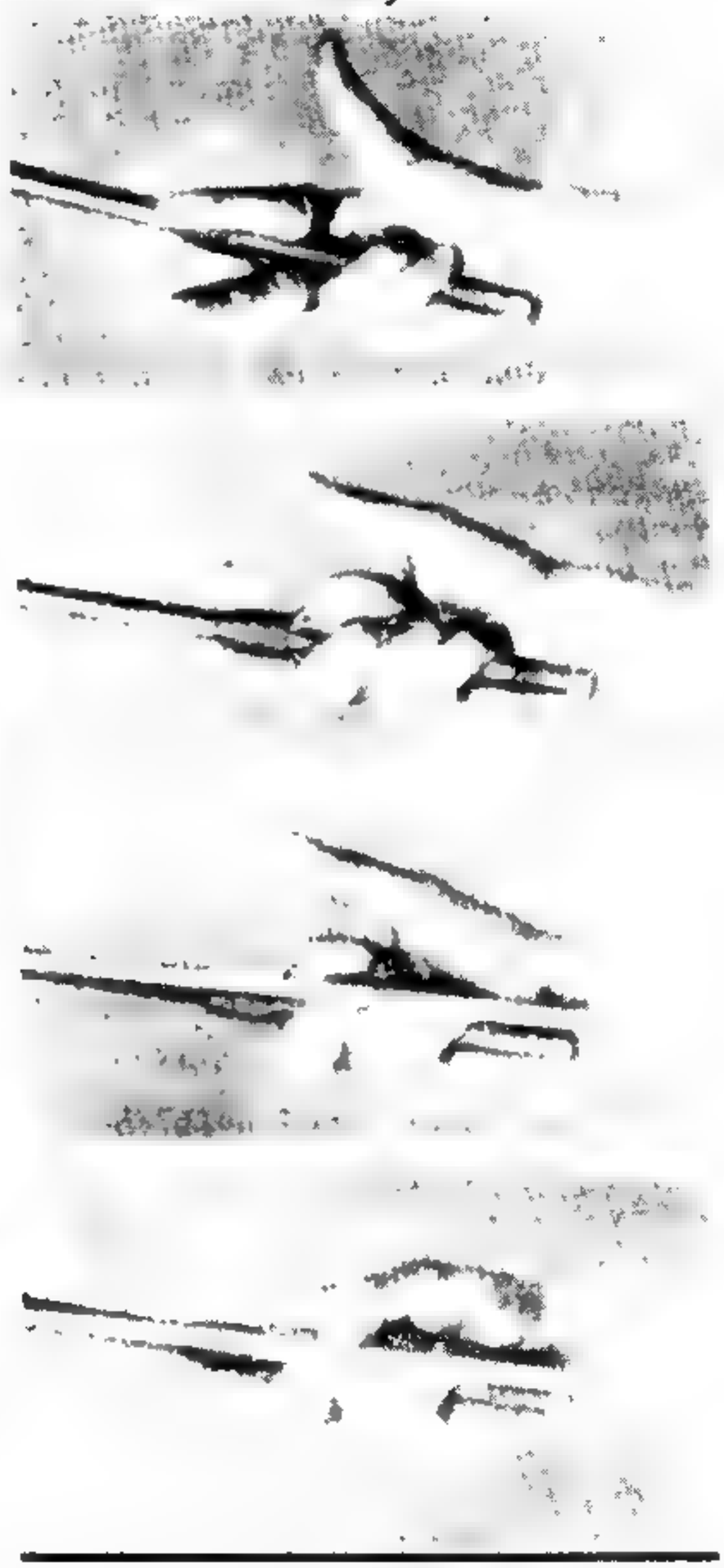


cord wrappings, leather fringes, and feathers, and have leather loops for the fingers. All three sticks can be cut from a piece of maple 5/8 by 3 by 30 in., as shown in a diagram near the end of this article. The stock for the handles is 5/8 in. square. The heads may be cut to any desired design and the handles rounded off and dressed down to about 1/2 in. round. The sticks are then sanded, stained, and polished.

The peg in each case is about 1/4 in. in diameter, with a ball formed on the end. A ball will follow the concave socket in the arrow through a greater length of stroke than a plain, straight point. The peg may be set at any angle from 45 to 80 deg.

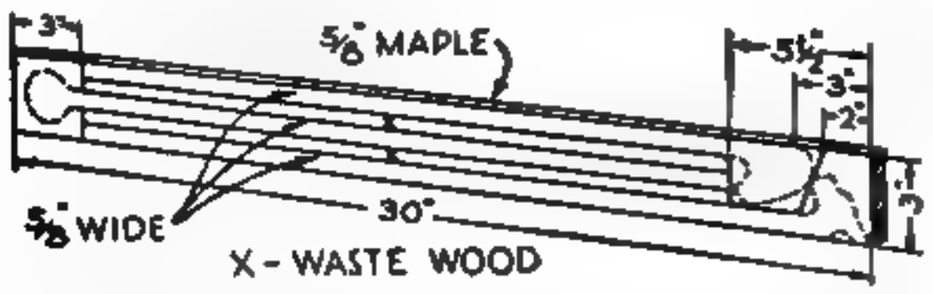
Glue the peg in a hole drilled in the head. Attach the finger loops and decorations with wrappings of cord such as chalk line. Pull the ends through under the wrappings to avoid knots. The wrappings may be stained with water colors and shellacked when dry.

Although arrows from 28 in. to 5 ft. in length may be used, the standard 28-in. target or hunting arrows obtainable at any sporting-goods store are probably the most practical. It is necessary merely to cut off the nock and form a round concave socket to match the rounded end of the peg. If you wish to make your own arrows, you will find instructions in any standard book on archery.



The method of gripping the stick is illustrated in the accompanying series of four photographs. The second, third, and fourth fingers grasp the handle, while the first finger is folded up out of the way. Place the arrow socket on the peg and lay the shaft along the first joint of the second finger, holding the shaft in place with the thumb. Use only enough pressure to keep it from falling off.

Stand with the feet apart, the left foot forward and pointing toward the target, the right



An economical way to cut three sticks from one small piece of maple or other hardwood

foot back and at right angles to the left, unless, of course, you are a left-handed thrower, in which case the position is reversed.

Draw the stick with the arrow in place straight back over the shoulder and execute a straightforward overhand swing. At the finish of the stroke, rock up on the right toes. Do not try to release the arrow with the thumb, as it is not necessary. If the thumb is pressed lightly against the arrow, but not lapped entirely over the top, the release will take place without conscious effort and at exactly the right time.

The throwing stick is by no means a toy. It has a range up to 500 ft., and the power is sufficient to inflict serious injuries. Use the same precautions as with archery. Be especially sure to have plenty of room when you first try out the sport. An archery target is the most convenient to use, but any type of target in which the arrows will stick may be used.

Do not allow children to use the throwing sticks unless under adult supervision. If you regard it as a weapon and use reasonable care, you will find it quite safe and will soon develop considerable accuracy. Continued practice will bring greater skill and increasing enjoyment in this unique and healthful sport.

Scientific American—May 11, 1861

EXPLOSIVE RIFLE BULLETS

The only superiority which breech-loading cannon has over those which are loaded at the muzzle, is that they are adapted for the use of explosive shells. We do not mean bomb shells, but those which are charged with powder and explode when they strike. Breech-loading rifles may be used for the same purpose in a most effective manner, and we revive our percussion explosive bullet, in order to draw attention to its destructive qualities. Fig. 1 is a section of it, and Fig. 2 represents it after striking and exploding. A is the hollow conical bullet, cast with a stem of lead, D; or this stem may be a common screw nail placed in the mold to form a pin for the sabot. B is a hollow chamber filled with percussion powder, and C is a plug fitted in the opening. E is a sabot made of cork fitted in the stem, D, and two pieces of leather, F, are glued to the sabot, which would be a little wider than the bullet. Such an explosive missile as this may be used for breech-loading rifled cannon, and by having the sabot of greater diameter than the shell, the latter need not be made with lead bands around it.

When used for cannon, the plug, C, should be made of iron: for rifles the plug may be a small conical

Fig. 1

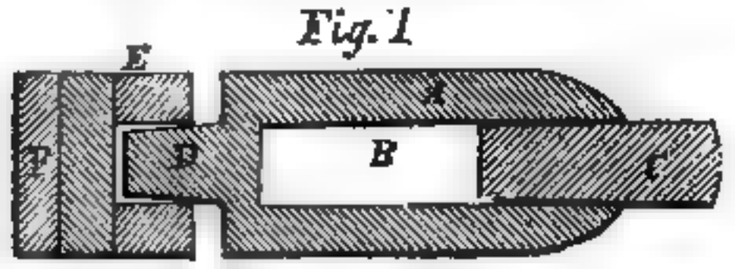
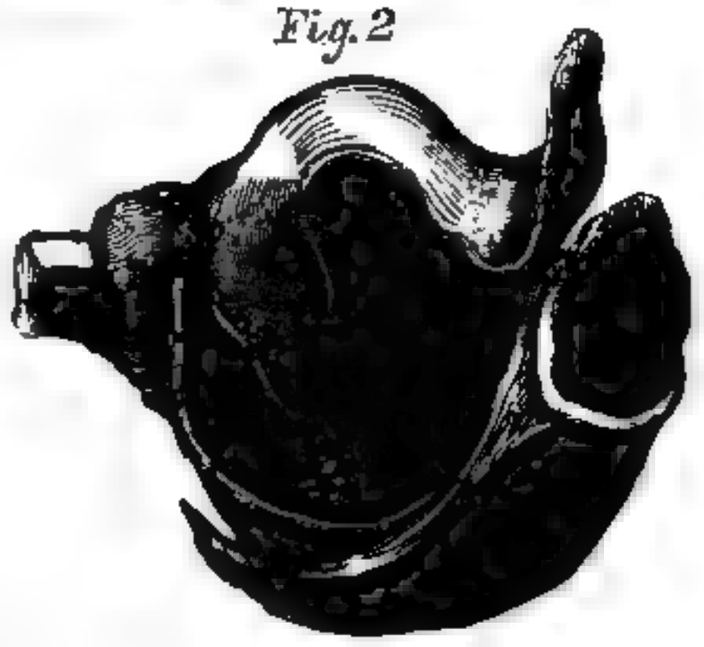


Fig. 2



glass tube filled with percussion powder. When the point of the bullet strikes an object, the plug ignites the percussion powder in the interior, B, and the shell explodes.

We would suggest an important improvement of General Jacobs on this explosive bullet, so as to render it as safe for carriage by a soldier as a common cartridge. It is this:—Instead of casting the bullet for a moveable plug, let it be cast for the insertion of a small conical fixed nipple, to be inserted after the shell is charged with the common powder, or gun cotton. When about to load the rifle with one of these shells, place a percussion on its point, and this, when it strikes, will ignite the charge inside.

The late General Jacobs, of the East Indian army, was a most consummate tactician for mounted riflemen. His troops were armed with double barrelled rifles, and were the terror of the natives during the great Indian rebellion. He made a host of experiments with explosive rifle balls; and he has frequently set ammunition wagons on fire at a distance of 1,200 yards with them. With the common rifle, by careful loading at the muzzle, General Jacobs also blew up caissons at 2,400 yards distance, at Enfield, England, in 1857, just with such shells.

In the Baden and Würtemberg German armies, rockets are used for small arms. These rockets are inclosed in copper tubes. Capt. Delvigne has also introduced these explosive bullets into the French army

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Scientific American—Oct. 12, 1861

How a Man feels Under Fire.

The Philadelphia *North American* says:—

How a man feels when in battle is a question that our volunteers have doubtless frequently asked themselves. We yesterday stumbled upon a volunteer on furlough, who first smelt powder at Bull Run. During an hour's chat with him he gave us a very good general idea of the way in which a man feels when

under an enemy's gun. Our friend didn't claim to be especially courageous. He placed due value upon the integrity of the American eagle, but enlisted mainly because he had no other employment at the time. He did camp duty faithfully, and endured the hardships of long marches without any special grumbling. That he dreaded to confront the enemy he freely admits. While willing at any time to kick a bigger man than himself under justifiable provocation, he disliked the idea of the sudden sensation imparted by a bayonet thrust in the abdomen, while only second to this was his horror of being cut down with a rifle ball like an unsuspecting squirrel.

When his regiment was drawn up in line he admits his teeth chattered and his knee pans rattled like a pot-closet in a hurricane. Many of his comrades were similarly affected, and some of them would have lain down had they dared to do so. When the first volley had been interchanged, our friend informs us, every trace of these feelings passed away from him. A reaction took place, and he became almost savage from excitement. Balls whistled all about him, and a cannon shot cut in half a companion at his side. Another was struck by some explosive that spattered his brains over the clothes of our informant, but, so far from intimidating, all these things nerved up his resolution. The hitherto quaking civilian in half an hour became a veteran. His record shows that he bayoneted two of his rebel enemies and discharged eight rounds of his piece with as decisive an aim as though he had selected a turkey for his mark. Could the entire line of an army come at the same time into collision, he says there would be no running except after hopeless defeat.

The men who played the runaway at Bull Run were men who had not participated in the action to any extent, and who became panic stricken where, if once smelling powder in the manner above described, they would have been abundantly victorious. In the roar of musketry and the thundering discharge of artillery there is a music that banishes even innate cowardice. The sight of men struggling together, the clash of sabers, the tramp of cavalry, the gore-stained grass of the battle-field, and the coming charge of the enemy dimly visible through the battle smoke—all these, says our intelligent informant, dispel every particle of fear, and the veriest coward in the ranks perhaps becomes the most tiger-like. At the battle of Bull Run the chaplain of one of the regiments, a man of small stature and delicate frame, personally cut down two six feet grenadiers in single combat. If these things are so—and we incline to think they are—the best cure for cowardice is to crowd a man into a fight and there keep him. The fugitives from Bull Run were men who imbibed panic before it could have reached them.

Scientific American—Oct. 19, 1861

THE HENRY RIFLE.

We take the following account of this famous weapon from *The Ironmonger*:—

At the close of last year we heard that some extraordinary practice had been made with a new rifle, patented by Mr. Alexander Henry, the well known gunmaker of Edinburgh, but as we could not obtain any information respecting the peculiar construction of the weapon, we concluded that its wonderful accuracy at long ranges was mainly owing to good workmanship. We imagined that the skillful gunsmith had turned out a very fine poly-grooved rifle, the novelty of which merely consisted in the number and form of the grooves. We never suspected that he had hit upon an entirely new principle in rifling fire-arms, and had produced a weapon far surpassing the famous Whitworth in precision. Had he been a military man, an engineer, or anything but a professed maker of guns, we should probably have given him credit for some originality.

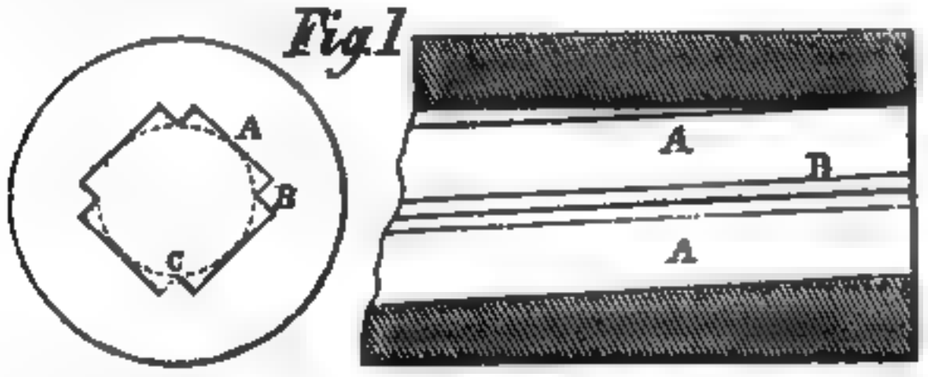
At the meeting of the National Rifle Association on Wimbledon Common, inJuly last, the Henry Rifle was first brought before the notice of our English marksmen, who were amazed at its performances. Sixteen important prizes and most of the pools were won with the new arm. Major Moir used it in the contest for the Prince Consort's Prize of £100, which he eventually carried off. Seven shots were fired at each of the ranges, 800, 900 and 1,000 yards, and the winner made twenty-one points. On the last day of the meeting an interesting match came off between Oxford, with the Whitworth, and Cambridge, with the Henry. Each University was represented by two of her best shots. The contest was got up for the purpose of testing both men and rifles. The Cambridge men were undoubtedly the finest marksmen, but their extraordinary score, which, if we remember right, doubled that of their competitors, is partly to be accounted for by the superiority of the Henry Rifle. Mr. Peterkin, with thirty shots, ten at each range, 800, 900, and 1,000 yards, obtained thirty-one points, the highest score ever made on Wimbledon Common at these great distances. Some wonderful shooting was made at the pool targets with the new weapon. Serjeant Dillon got eleven consecutive two-inch bull's eyes at 100 yards. Lord Elcho with seven shots at 200 yards, made six consecutive four and a half-inch bull's eyes and one center.

At the recent meeting of Scottish marksmen at Montrose, the Henry has again made itself heard. With it Mr. Edward Ross won Scotland's Cup, and the first long-range prize or Stranger's Cup. Major Moir succeeded in carrying off the third prize with the very weapon which had proved such a trusty friend at Wimbledon.

In one of the early trials of the rifle Mr. Henry himself fired six shots with it at the extraordinary range of 1,100 yards, and hit the target with every ball, except the first, making three centers and two outers. At the mile range he afterward hit the target, which was six feet high by ten wide, three times out of seven shots. Several military men witnessed this wonderful shooting. In a quiet trial of skill between the famous marksman, Mr. Edward Ross, and his father, "the old deer-stalker," near Aberdeen, the precision of the new

weapon at long distances was strikingly shown. The ranges were 800, 900, and 1,000 yards, and each competitor fired ten shots from a Henry at each range. The father made with his thirty shots, thirty-four points; the son no fewer than forty-three points, only missing the target once. Capt. Moir, on the 23d of April, fired twenty-one shots with this arm at 1,000 yards, and got seven centers, twelve outers, and two misses, counting twenty-six points. These examples of practice made with the Henry will suffice to account for the popularity of the arm. Though its history only begins in 1860, it is now the favourite weapon of many of our most skillful marksmen, and it is generally selected for the first prize by County Rifle Associations. We will now endeavour to describe the most striking features of Mr. Henry's invention. In his specification he claims a system or mode of rifling or grooving firearms, in which a series of planes or flat surfaces are combined with angular, curved or rectangular ridges or "lands." In the explanatory sheet of drawings several modifications of this improved mode of rifling are shown. From four to ten planes and ridges are used in the various forms of the new rifle. The simplest modification is shown in Fig. 1. This barrel is rifled so that its end view or transverse section forms a quadrilateral figure, with angular projections, or "lands," extending inward from the angles of the planes. The periphery of the projectile, *c*, indicated by a dotted circle, touches the center of each plane, *a*. In addition to the bearing surfaces thus obtained there are the angular ridges, *b*, which project inward, so that the apex of each is exactly concentric with the centers of its contiguous planes. These four ridges thus afford a further bearing or support to the projectile. These angular ridges also fill up to a great extent the spaces between the angles of the planes, A, and the periphery of the projectile, thus reducing the windage

Fig.1

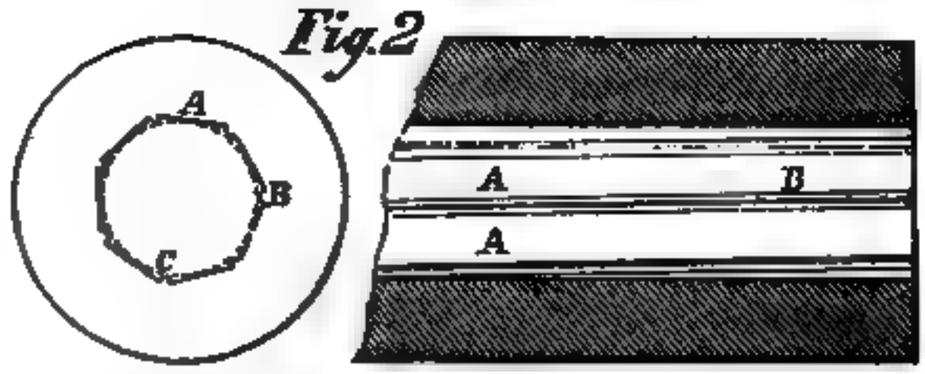


by lessening the amount of expansion necessary to cause the projectile to fit the grooves of the rifle or other fire-arm, so that the rotary or spiral motion of the projectile is obtained with greater certainty, and consequently its flight is rendered more accurate.

Mr. Henry rarely makes rifles with this quadrilateral bore, but the figure shows this principle so clearly that we have reproduced it here.

In Fig. 2 the favorite modification is shown:— There are seven planes, A, and a corresponding number of intervening ridges, B, which together afford fourteen points of bearing to the projectile, C, which very nearly fills up the whole of the bore. This is the form of the ordinary Henry. Rectangular or rounded ridges are occasionally substituted for the angular ones shown in the diagrams.

Fig.2



In another modification of the new system of rifling, curvilinear grooves are combined with a series of planes. The planes form a polygon, but in the center of each plane a curved groove is formed, and the ridges or boundary lines of the grooves form the bearing points for the projectile.

A larger charge of powder may be used with firearms rifled on Mr. Henry's principle than with others, as there is less liability of stripping the bullet. The increased charge gives a lower trajectory, and ensures greater accuracy in the flight of the missile.

The bore of the Henry is somewhat larger than that of the Whitworth, and the ball is about the same length. The ball fits easily into the barrel, and there is very little recoil. The advantage of the bore seems to lie in the extent of surface which is made to present a resistance to the shifting of the ball in the slightest degree from the grooves, which give it its rotary motion and direction, and in the perfect manner in which the expansion of the ball fills the grooves. The resistance of the air to the ball is so slight that at the marker's butt at the mile range, neither the report of the rifle nor the whistle of the ball is heard; and it is only by the ball hitting the ground or the target that the marker knows when a shot has been fired.

The arm does not foul so rapidly as other muzzle-loaders; indeed we heard the other day of a Hythe instructor who had been firing with a Henry for two months, and had never thoroughly cleaned it.

Mr. Henry's patent wind-gage sight is a beautful and simple contrivance for regulating the aim according to the strength of the wind. The sight, either back or front, can be moved to the right or left by an ordinary watch key, and when set to the proper degree it may be shaken or handled without fear of altering its position. With the back windsight, if the wind blows from the right the sight must be moved to the right, and with the front windsight, to the left. The degrees are marked by alternate lines of gold and platinum.

The wonderful practice made with Mr. Henry's rifles proves that the principle upon which they are constructed is a good one.

Scientific American—July 27, 1861

SCIENCE IN MODERN WARFARE.

At the Brooklyn navy yard there are a number of old brass cannon which were captured in Mexico, and preserved as trophies. Great care has been taken to give them graceful forms, and they are covered with ornaments.

In the same yard are a number of Dahlgren cannon. These are simple masses of cast-iron, without an ornament upon, and with no attempt at beauty in their forms. But how great is the contrast in the amount of brain-work represented in these two species of ordnance! The Dahlgren guns are of immense size at the breech, tapering sharply down in the neighborhood of the trunions, and terminating in a chase but slightly conical towards the muzzle This disposition of the metal has been determined by a long and costly series of experiments, conducted in the light of an immense amount of knowledge of the properties of metals, with an intelligent consideration of the forces of expanding gases, of the laws of moving bodies, of the results of chemical decomposition and combination, nearly all of which knowledge has been acquired by mankind since the Spanish cannon were cast.

Before Capt. Rodman cast his 450-pounder cannon, illustrated on page 805 of our last volume, he made a series of experiments to determine not only the best kind of iron to be used in the casting, but also the proper form for the mammoth ordnance. The extent and variety of knowledge made available in determining the form of this simple mass of cast-iron, may be judged by the following list of only a small part of the subjects discussed in Capt. Rodman's report:

"Of the various kinds of strains to which a gun is subject at each discharge.

"Tangential strain.

"Longitudinal strain.

"Crushing force.

"Transverse strain.

"Expressions for tendencies to rupture different kinds of resistance.

"Bursting effects of different weights of powder and shot in guns of different caliber.

"Position of shot when maximum pressure is attained.

"Experiments made for the purpose of determining the relative endurance of guns made from the same iron, but melted in furnaces of different construction.

"Deflection of bars under loads equally distributed along their whole lengths.

"Thickness of metal in the breech.

"Effects of compressibility.

"Termination of bore."

After these, and over forty other subjects of a similar character, are discussed in detail, with many pages of algebraic computations, the lines of the gun are finally drawn, and the mixture of cast iron, with its number of meltings, the form of furnace, &c., is prescribed, and the gun is cast.

Even these facts give but a faint idea of the amount of knowledge and study that is embraced in the production of one of our large pieces of ordnance! The books, which it would be the grossest folly not to read before the experiments are commenced, would form no inconsiderable library.

And all this has reference to only one species of cannon, that which is adapted to sea-coast defense. The ordnance department embraces the various varieties of field artillery, with their carriages, locks, powder and projectiles, round and elongated shot, shells, case, grape, canister and shrapnell. The arming of the infantry and cavalry is a not less extensive study. All of the details of arms for all classes of soldiers have been the subject of costly experiments by the leading governments of Europe, and of elaborate discussions by the foremost minds of all civilized nations.

But the arming of soldiers is only a small portion of the art of war. The equipment, the subsistence, the organization, the transportation of armies, is each a science in itself.

All history proves that the success of military operations depends almost wholly upon the intelligence with which they are conducted. The American people, aware of this, have, with prudent forecast, made ample provision for the education in the military art of a sufficient number of our citizens to lead our armies in case of war.

The politicians who had the control of our affairs at the time of the Mexican war, set aside these men who had made the art of war the study of their lives, and entrusted the commmand of our brigades to men who had spent their lives in learning something else—lawyers and politicians like themselvvs. In this war, we rejoice to see that the popular intelligence, always in advance of that of the politicians, is indeavoring to enforce a different policy. Our educated volunteers insist on being led by skilled officers, who, if they do sacrifice the lives of their soldiers, will not do it uselessly in securing defeat.

RATIONS FOR TROOPS

Scientific American — April 7, 1860

At the Division Armory in this city, General Yates has ordered the troops to be supplied as follows: —

For breakfast, at seven A.M., there will be furnished for each man provisions in the following quantities; — One quart of good coffee, eight ounces of bread, and three-eighths of a pound of beef.

At twelve M., for dinner: — Five-eighths of a pound of beef or mutton, well cooked, with potatoes; one quart of baked beans to every ten men; and every other day, in lieu of baked beans, rice, bean or vegetable soup will be furnished at the rate of one pint per man.

At five P.M., for supper: — Eight ounces of bread, three pints of coffee, one quarter pound of cold beef or mutton. The coffee to be furnished will be properly sweetened, and milk in due proportion will also be provided.

Scientific American—July 6, 1861

OLD CHINESE WROUGHT-IRON BREECH-LOADING CANNON.

At the establishment of Messrs. McKee & Judson, iron dealers, 457 and 459 Water street, in this city, there is a large quantity of old iron which came from China as ballast in the clipper ship *Flying Scud*, and among it are a large number of old Chinese wrought-iron cannon, several of which are breech-loading. The *Flying Scud* was employed by the British government as a transport during the Chinese war, and was

furnished with this quantity of old iron as ballast, and when she came home an arrangement was made for it to remain in her hold, hence its appearance in our port.

All of these wrought-iron cannon are curiosities, but the greatest interest attaches to those which load at the breech. In the first place, they are of great age. Experienced persons on seeing them pronounce them without hesitation one hundred years old, judging from the rust upon their surfaces. Distrusting the accuracy of this criterion, it is still impossible to look at them without being convinced that many years have passed sinced they were forged. They are of very peculiar fashion, and we give an illustration of one of them from an accurate drawing made for the purpose by our artist.

They are all of nearly the same size, and the dimensions of the one represented are as follows :— Length, 5 feet ; diameter at breech, 7 inches ; diameter at muzzle, 5 inches ; diameter of bore, 2½ inches.

The bore at the breech is widened by successive cylindrical enlargements, as represented in the dotted lines, and in the rear of this the external shell of the cannon is continued for a length of fourteen inches in the form of a hollow trough open on the upper side. Through each of the sides of this trough is a slot, doubtless intended for a key to hold the breech piece in place. The breech pieces are missing, and whether they were chambered in front to receive the charge, or whether the latter was placed in the bore of the gun, it is impossible to determine.

It is well known that breech-loading cannon were tried in Europe soon after the introduction of the use of gunpowder. Still, this proof of their having been employed by the Chinese so long ago will attract attention at this time.

The muzzle-loading wrought-iron cannon that came out in the *Flying Scud* are considerably larger than those which load at the breech, and the ability of the Chinese to forge these large masses with their little hammers has excited considerable surprise among our mechanics.

It is said to be a universal rule, that in the infancy of the arts great skill is displayed in the use of poor tools, and that as civilization advances better tools are devised, requiring shorter training in those who employ them.

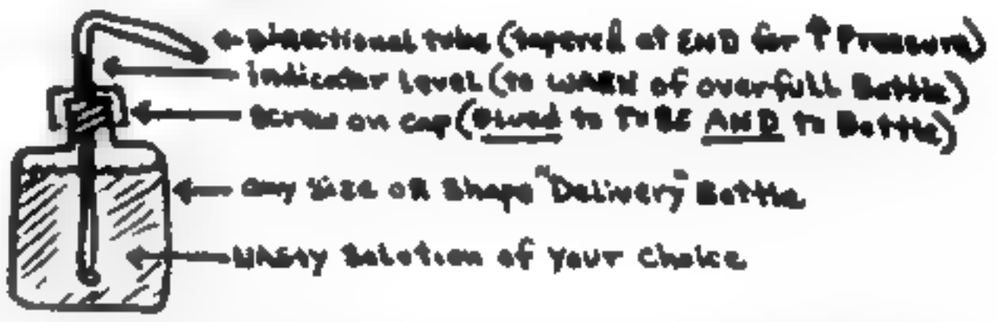
Letter

Dear Kurt:

Concerning the nasal spray article in issue 1; most chemical supply houses carry plastic squirt bottles (your local pharmacist either has them in stock or will order some for you. Ed.) They come in all shapes and sizes. The caps have directional, leakproof screw-on plastic tubes. Directional tubes can be fitted to your favorite nasal spray bottle for increased range and accuracy. A product label soaked off some other medicinal bottle and glued to your new spray will disguise its true nature.

I find that body heat increase the volume of solutions I carry. But directional tubes take up this increased volume and indicate when I'm carrying a bottle that is too full before it leaks. The bottle can be neatly and safely filled in the same sucking up manner you described, through the tube.

I carry twin plastic flasks taped together so that one squeese squirts both bottles. One bottle holds concentrated Ammonium hydroxide and the other holds concentrated, "fuming" Hydrochloric acid. One whiff of either chemical will knock anyone to his knees (try it), and a couple of drops in the mouth, nose or eyes will usually produce unconsciousness within seconds. An average squirt of one second's duration in the face and your attacker will never breath on his own again. Plus, these two chemicals squirted together, produces a dense white smoke identical to burning white phosphorous. So if your attacker is with friends, they will not care to share his fate. If they can't get away, you can rob them all at flask-point.



I also add a few drops of red food dye to my solutions so if I do spring a leak I have time to save my skin.

Robert B.

Dear Robert:

The squirt flask and your mixtures are good ideas. However, I don't see much sense in the dye. Say you have your flask in your shirt pocket and it springs a leak. If you were wearing a jacket you wouldn't see the stain. You certainly wouldn't see the stain in another pocket. Besides, by the time you noticed any stain you'd still be doomed, the only difference being that you'd have some of your tissues dyed red as the DMSO spreads it through the system. Also, what of your victim? If you want passers-by to think he's had some kind of seizure, how will the red stain be explained?

Leaks from modern plastic bottles are little to worry about. I've never had any trouble with them. If you are worried, wrap yours in a couple of paper towels and carry it around for a day. If the paper is still dry after a day, I think it's safe for you to carry.

Ed.

Making Lead Shot in 1814

I was fortunate in picking up Vols 2 and 3 of THE EMPORIUM OF ARTS AND SCIENCES, 1812 to 1814. They remind me a lot of THE WEAPONEER, in that succeeding entrants corrected the errors of their fellows. Unlike THE WEAPONEER, there was little mutual agreement at the end of the series so later readers had to prove out the processes. Of course, science was in its relative infancy in those days so no one knew much of anything for sure. It's an education in itself to see how various processes evolved from the putterings in private laboratories and workshops of the 19th century intellectuals and small manufacturies to the impersonal mass production of our times.

The confusion concerning arsenic and its various names, such as orpiment and auropigmentum arose from the degrees of purity and also from regional differences in naming compounds.

The old ways may not be the best, after all. But if you are not equipped to implement the best, often the old ways are the only ways. At least, they are a place for you to start with the best facilities you have on hand.

Shot. Is made by melting lead with arsenic, and pouring it out of Troughs from a great height into a large vessel of water. The height is intended to give rotundity to the shot: the arsenic to make it more fusible, so that it shall preserve its rotundity arising from its liquid state until the moment when it is required to be condensed. Mr. Paul Beck's shot manufactory at Philadelphia, is, I believe, 175 or 180 feet high. The first fall for small shot is about 130 feet, the second fall or melting place, is about 170 feet high.

I give below the common English processes: but in my opinion the practice is, to melt the whole quantity of arsenic, with a small portion of the lead first: and then to add this strongly arseniated lead to the unalloyed lead, when the latter is melted. The arsenic, *should not be orpiment.* It should be white arsenic. It should be mixed with three or four times its bulk of charcoal, lamp-black, rosin, or some carbonaceous or inflammable substance, and being tightly inclosed in several folds of paper, should be thrust down with a stick to the bottom of the lead. The pan of melted lead, should be then covered, in order to aid the impregnation of the lead with the arsenic. The pan should be of thin cast or thick sheet iron; for the heat must not be too great. It is right, when the surface of the lead is irridescent.

As the general method of making shot is kept a secret, I give all the processes I have.

Patent Milled Shot, is thus made; sheets of lead, whose thickness corresponds with the size of the shot required, are cut into small pieces, or cubes, of the form of a die. A great quantity of these little cubes are put into a large hollow iron cylinder, which is mounted horizontally and turned by a winch; when by their friction against one another, and against the sides of the cylinder, they are rendered perfectly round and very smooth. The other patent-shot is cast in moulds, in the same way as bullets are.

Common Small Shot, or that used for fowling, should be well sized; for, should it be too great, then it flies thin and scatters too much; or if too small, then it has not weight and strength to penetrate far, and the bird is apt to fly away with it. In order, therefore, to have it suitable to the occasion, it not being always to be had in every place fit for the purpose, we shall set down the true method of making all sorts and sizes under the name of mould-shot, formerly made after the following process:

Take any quantity of lead you think fit, and melt it down in an iron vessel: and as it melts keep it stirring with an iron ladle, skimming off all impurities whatsoever that may arise at top; when it begins to look of a greenish colour, strew on it as much auripigmentum or yellow orpiment, finely powdered, as will lie on a shilling, to every twelve or fourteen pounds of lead; then stirring them together, the orpiment will flame. The ladle should have a notch on one side of the brim, for more easily pouring out the lead; the ladle must remain in the melted lead, that its heat may be the same with that of the lead, to prevent inconveniences which otherwise might happen by its being either too hot or too cold; then, to try your lead, drop a little of it into water, and if the drops prove round, then the lead is of a proper heat; if otherwise, and the shot have tails, then add more orpiment to increase the heat, till it is found sufficient.

Then take a plate of copper, about the size of a trencher, which must be made with a hollowness in the middle, about three inches compass, within which must be bored about 40 holes according to the size of the shot which you intend to cast: the hollow bottom should be thin; but the thicker the brim, the better it will retain the heat. Place this plate on a frame of iron, over a tube or vessel of water, about four inches from the water, and spread burning coals on the plate, to keep the lead melted upon it; then take some lead and pour it gently on the coals on the plate, and it will make its way through the holes into the water, and form itself into shot; do thus till all your lead is run through the holes of the plate, taking care, by keeping your coals alive, that the lead does not cool, and so stop up the holes.

While you are casting in this manner, another person with another ladle may catch some of the shot, placing the ladle four or five inches underneath the plate in the water, by which means you will see if they are defective, and rectify them. Your chief care is to keep the lead in a just degree of heat, that it shall be not so cold as to stop up the holes in your plate, nor so hot as to cause the shot to crack; to remedy the heat, you must refrain working till it is of a proper coolness; and to remedy the coolness

of your lead and plate, you must blow your fire; observing, that the cooler your lead is, the larger will be your shot; as, the hotter it is, the smaller they will be.

After you have done casting, take them out of the water, and dry them over the fire with a gentle heat, stirring them continually that they do not melt; when dry, you are to separate the great shot from the small, by the help of a sieve made for that purpose, according to their several sizes. But those who would have very large shot, make the lead trickle with a stick out of the ladle into the water, without the plate. If it stops on the plate, and yet the plate is not too cool, give but the plate a little knock, and it will run again; care must be had that none of your implements are greasy, oily, or the like; and when the shot, being separated, are found too large or too small for your purpose, or otherwise imperfect, they will serve again at the next operation.

Shot, tin-case, in artillery, is formed by putting a great quantity of small iron shot into a tin cylindrical box called a cannister, that just fits the bore of the gun. Leaden bullets are sometimes used in the same manner; and it must be observed, that whatever number or sizes of the shots are used, they must weigh with their cases nearly as much as the shot of the piece. [*Greg. Encyclo.* 665.

Lead, how formed into shot. Lead is employed in considerable quantities in the casting of shot, for which a patent was granted in 1782, to Mr. William Watts, in consequence of his invention for granulating lead, solid throughout, without those imperfections which other kinds of shot usually present on their surface. The patentee directs 20 cwt. of soft pig-lead to be melted in an iron pot, round the edge of which, a peck of coal-ashes is to be strewed upon the surface of the metal, so as to leave the middle of the latter exposed. Forty pounds of arsenic are next to be added to the uncovered lead, and the pot closely shut; the edges of the lid being carefully luted with mortar, clay, or other cement, in order to prevent the evaporation of the arsenic. A brisk fire is then kindled, so that the two substances may be properly incorporated, when the metal ought to be skimmed and laded into moulds, that it may cool in the form of ingots or bars, which, when cold, are called *slag*, or poisoned metal—20 cwt. of soft pig-lead, (according to the quantity of shot intended to be manufactured) are next to be melted in the manner above directed; and, when it is completely liquefied, one of the ingots or bars of slag must be added: as soon as the whole is combined, a small quantity of the liquid metal is to be taken out with a ladle, and dropped from a height of about two feet into the water. If the shot be not perfectly round, it will be necessary to add more slag, till it drops in a globular form. The metal is next skimmed, and the scum poured into an iron or copper frame perforated with round holes, according to the size of the shot designed; the scum is then to be squeezed while soft, through the frame, into which the liquid should be poured, and dropped through the holes. For the smallest shot, the frame must be at least ten feet above the water, and for the largest, about 150 feet; the height being increased or diminished, in proportion to the size of the shot. [1 *Art. Man.*

Shot Manufactories have lately been established or revived, and appear to promise to supersede the importation of English shot. They are manufactured principally from Lead found in Louisiana, and shipped from New-Orleans.

Patent shot, as Dr. Black has informed us, are manufactured in England as follows:

A little orpiment or arsenic is added to the lead, which disposes it to run into spherical drops much more rapidly than it would do when pure. The melted lead is poured into a cylinder, whose circumference is pierced with holes. The lead streaming through the holes soon divides into drops, which fall into water, where they congeal. They are far from being all spherical, many being shaped like pears, and must be picked. This is done by a very ingenious contrivance. The whole is sifted on the upper end of a long, smooth, inclined plane, and the grains roll down to the lower end. But the pear-like shape of the bad grains makes them roll down irregularly, and they waddle as it were, to a side; while the round ones run straight down. They are received into a sort of funnel, which extends from the one side of the inclined plane to the other, and is divided by several partitions, so that it is really the mouth of several funnels, which lead to different boxes. Those in the middle receive the round grains. [2 *Art. Man.*

The shot when made, is separated into sizes by means of sieves, whose wires are set according to the different sizes required. The shot is glazed by putting them into a barrel and turning it round, till by the friction and attrition they become perfectly round, smooth and shining.

I believe in this country, the proportion of arsenic is nearly as follows. About 7 lb. of arsenic is first added to about five hundred weight of the metal. Then of this mixture, so much is taken to add to the fresh lead, as will make the proportion of arsenic about 2 1-2 or 3 lbs. to the ton. Of this about one half a pound will evaporate. Compare this with the English patent proportions above given.

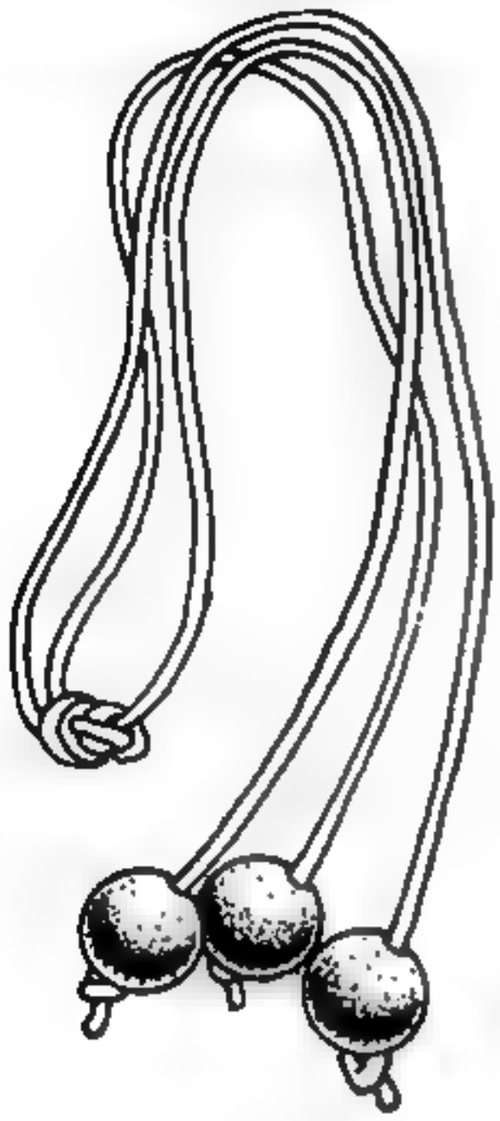
In the Louisiana country, shot manufactories are established, where the shot is made by letting the lead fall from the top to the bottom of the bank of the Mississippi, at low water: so that the enormous expence of such a building as that in Philadelphia, is saved. T. C.

The Price of Enfield Rifles

Scientific American—Oct. 12, 1861

The price of fire-arms in England has greatly advanced in consequence of the demand from the United States. The Enfield rifles, which cost formerly fourteen dollars, now sell for twenty-one dollars. As the old muskets rifled, which any of our machine shops would soon effect, are said to be equal to the Enfield rifle, we do not see why we should pay such an enormous price abroad for arms which can be so easily supplied at home.

The Deadly Fighting Bolas



By KURT SAXON

A little known and underrated weapon has been the bolas. It consists simply of three balls, or weights, of metal or leather-covered rock, tied to three equal lengths of cord, knotted at the end.

The Argentine gauchos have used the bolas for centuries for the same purposes the American cowboy uses the lariet. A gaucho can whirl a bolas and catch a calf or bull around the fore or hind legs with just as much skill and effect as any cowboy with his rope.

The bolas as a weapon should have lead weights. It should have great power to entangle and also to stun or kill.

A skillful user of the bolas can trip up an approaching or escaping enemy by wrapping the weighted cords around his legs. Better still, is to kill him by hurling the flailing scourge so it wraps around his neck and head, choking him and/or breaking his skull.

The bolas is not limited to throwing. When held by the knot at the end of the cords and swung around the head, you can make any sub-human rat pack stay well away, if they don't have guns.

I don't care if it's a 300 lb. psycho or a Karate expert; if you can lift and swing 10½ ounces, you can defeat any lesser armed opponent.

Throwing the bolas takes some skill. After about 200 throws you'll begin to get the hang of it. You start by holding one weight in your throwing hand and swinging the other two around your head.

Be sure you're in a cleared space with a tree or post as a target. Hay bales or a blanket or something else soft wrapped around your target will keep the lead weights from losing their shape on impact, for the impact is indeed great.

Start a gentle swing, extending your arm above your head. If you aren't well enough coordinated to keep the whirling weights above your head, you'd better stick to name-calling. Extreme carelessness or using while intoxicated could mean the end of you.

I'm sure you've heard of the Nunchaku, the oriental rice flail consisting of two foot-and-a-half lengths of broomstick connected by about six inches of chain. This is dramatic to watch but illegal to carry and hardly concealable.

The best Nunchaku man would not stand a chance against an indifferent user of the bolas. And the bolas is easily concealed. Of course, if you just carry them in your pocket, they'll be all tangled and this won't do at all if you're attacked. So I naturally invented a carrier for the bolas to make them instantly accessable, without tangling.

I bought a length of plastic plumbing tubing from the hardware store. It is 1 5/16th of an inch across. Tubing slightly smaller would do as the weights are one inch across. Even so, you don't want too snug a fit, so that size is fine, whereas a larger tube could allow tangling.

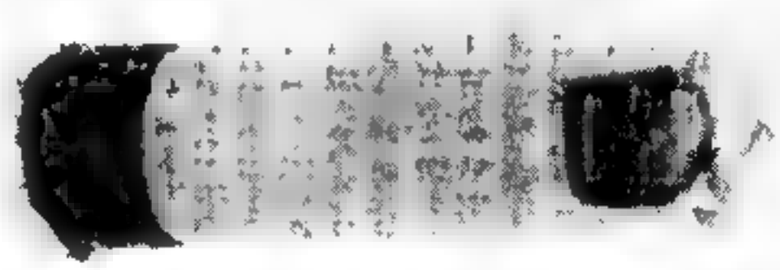
Anyway, I cut the tube four inches long. Then I cut out a circle of cardboard for the bottom. After fitting the cardboard inside the bottom of the tube I put lengths of electrical tape across it, then put a strip around the bottom to make it look uniform.

Then I sawed two 3/4 by 3/4 inch slots in the top and broke them off. This enables one to grasp the sunken weight with the thumb and forefinger and pull the bolas out with one smooth, easy motion.

To hold the tube, you should sew a pocket to the inside of the front of your pants about three inches to the left of the zipper and about one inch below the waistband. (Left-handers put the pocket three inches to the right of the zipper).

To make the pocket, simply cut a 4½ by 4½ inch square of heavy cloth. Sew it with the same color thread as your pants. It's such a small job you don't even need a sewing machine.

The pocket should be snug. But if yours is so loose the tube might come out when you yank the bolas, either sew another stitch in closer or use a large safety pin. Push the pin through the waistband and around the thinnest



lip of the tube. That way, there is plenty enough room to withdraw the bolas, the tube will not creep up in the pocket and the safety pin will be hidden by your belt.

Say you want it ready to use as throwing bolas. Put one weight in the tube and push its cord down on top of it. Do the same with the second weight. Keep out the last weight and push its cord into the tube and then put it in and push it down just so it is even with the top of the tube.

If you don't expect to be actually throwing the bolas, pack the weights so the knot projects to where a weight would normally be. A quick and effortless tug on the knot will have the clonkers ready to swing in a second.

With the tube in the pocket, just so, there is no noticeable weight nor any pressure on the abdomen; unless you wear your pants very tight in the waist.

Don't let the simplicity of this weapon or its origins make you despise it. It is lethal, concealable and instantly accessable. With it, you need fear no one lesser armed.

Saxon's Ultimate Fang

By Kurt Saxon

How often have you longed for a weapon which is lethal, silent, concealable, quick, cheap and untraceable? I couldn't find one so I invented the Ultimate Fang. Egomania demanded I give it my name.

It is a new concept in weaponry, similar to the tranquilizer darts shot from guns. But since those and the guns to shoot them from are unavailable to the public, my Fang will have to do.

It is a hypodermic syringe with needle which, upon penetration, automatically injects 2 ccs of poison into your opponent's system.

Examine Figure 6. When the barb and needle enter the flesh, the bent end of the paper clip and the cutter is pushed back, cutting the fish line holding the rubber band. Upon release, the rubber band pushes the plunger, which empties the hypo.

The Fang is first loaded with the poison of your choice and carried in the holder diagrammed in Figure 8. If you need personnal contact with an opponent, you simply remove the holder's cover, approach him from behind and jab the protruding point into his rump.

The fish hook barb will hold it in and the poison will be automatically injected into his system before his reaction time will let him yank it out. By that time, 2 ccs of death will have poured in and only the Great Pumpkin couldn't keep him alive for more than a few seconds.

If you anticipate a mugging or other attack, have the cover off and the Fang upright. Best to jab it into a fleshy part of his arm, upper thigh, throat, cheek or belly. The suprise of your attack, the penetration and his own reaction time will doom him before he can stop its lethal flow.

If you prefer to hit him from a distance, you'll want a blowgun. The Fang will go with great force and accuracy for a distance of from 20 to thirty feet, depending on your lung power. This is plenty if you are lurking around a corner or sitting in a car at the curb. Anyone walking by or entering or leaving a building is within easy range.

If you must practice on live prey, sit in your car on a Saturday night when the wierdos prowl your downtown area. Best to sit on the passenger's side in front and shoot through the rear window. When you see a likely degenerate; fag, pimp, punk or Liberal, aim at the face, belly, thigh or rump and let fly. Then, dissasemble the blowgun, drop it behind the back seat, scoot behind the wheel and drive off. The Fang you leave behind is untraceable. Hundreds of millions of throwaway hypos are sold each year all over the country by the same company. Also, there is too little surface area which could hold a recognizable print. Just in case, you might wipe the tube and the tape with a cotton swab just before putting the Fang in its holder.

Don't worry about being observed by passersby. The more people there are, the better your chance of going unnoticed. Urbanites seldom see anything they aren't on the make for so you can act with impunity. Most likely, their only reaction to the victim's death throes would be to steal his watch or cop a feel.

Now to the making of the Fang. It is simple to put together, requiring no skill or special equipment. Nearly everything used in its construction, except the hypo, can be gotten from your local supermarket, hardware or dime stores.

The hypos are B-D (Beck-Dickenson) 3 cc 21 G 1 syringes, bought at about $25.00 per 100 from any pharmacy. Here in the Free South, anyone can buy them individually or by the box on request.

Figure 1 shows the hypo as it comes from the manufacturer. Pull out the plunger and clip off two edges with scissors as shown in Figure 2. This allows the rubber band to rest firmly.

Next, clip off the rubber ring (middle illus. Fig. 2) nearest the plastic. This is not necessary if you intend to deliver it by hand. But the double ring presents a problem when the Fang is shot from a blowgun. Having two rings makes it tend to bind to the sides of the tube, needing a little extra pressure, which can't be applied once it's left the blowgun.

With a razor knife, cut through the tube to remove the finger holds (Fig. 1).

Next, drill or burn a hole through which to tie the release mechanism in place. (Examine the far right diagram in Figure 2). Put the plunger in so the first ring rests on the 2 cc mark, as in Figure 4, and is turned so the clipped end is on its side. Then, unbend a paper clip and hold one end of it in the fire to make it red hot.

Burn the hole through the tube and directly behind the plastic circle at the business end of the plunger. If you burn it, you'll have to remove the plunger and cut off any melted plastic that might stand out and catch on the tube. It's better to use a 1/16th inch drill.

The needle has to be cut in half and reground. This is to keep it from bending on impact and the regrinding is to prevent the tip from clogging as it enters.

For regrinding, I use a fine wheel and put the needle to its rim edge to cut, then angle it on the flat part of the rim so the reground tip is the same shape as the original. The wheel tends to burn it so any ash must be scraped from the tip. However you do it, use a darning needle to scrape out any ash, burrs or filings that might clog the tip.

If you have no grinder, just cut the needle with a scissors and regrind the tip with an emery cloth or stone. Just make sure the tip is clear and test it by filling. If the liquid doesn't squirt out straight, it's clogged. So keep scraping and reaming until you get it right. It just takes a minute.

As shown at the right of Figure 3, shove the hypo needle through the middle of the end of a No. 62 to 63 rubber band you can buy from any of-

PARTS FOR SAXON'S FANG

FIG. 1

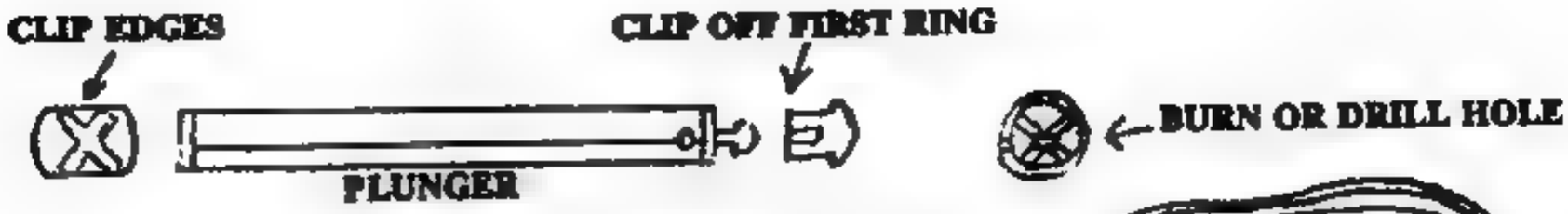


FIG. 2

FIG. 3

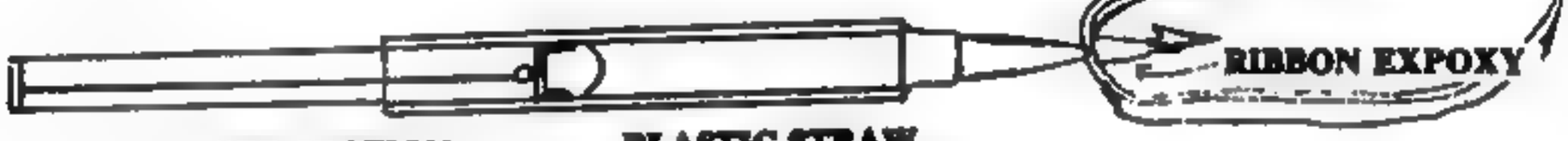


FIG. 4

FIG. 5

FIG. 6

FIG.

FIG. 8

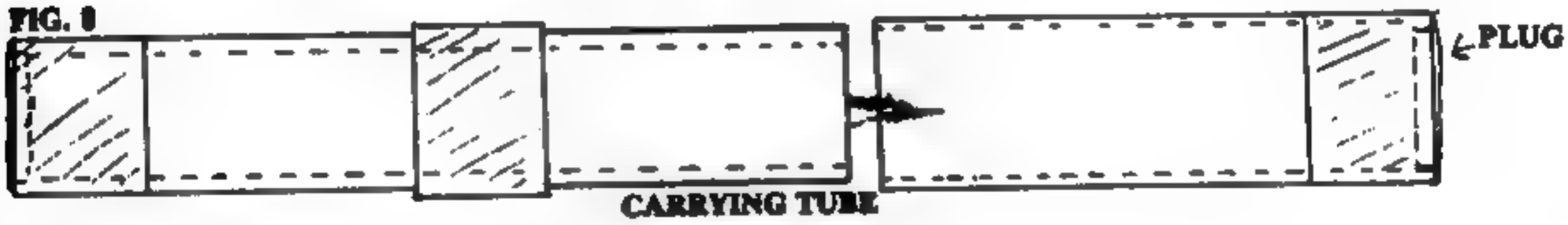


FIG. 9

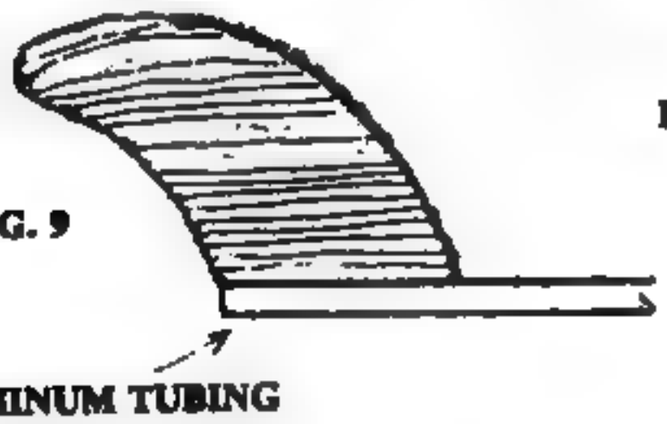
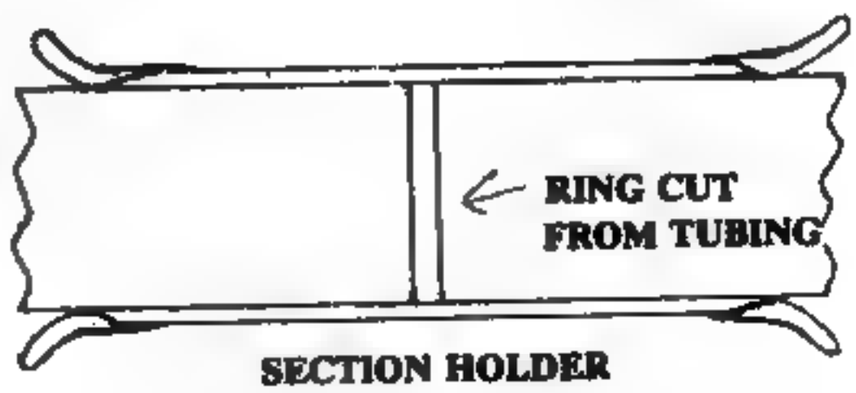


FIG. 10

SECTIONED BLOW GUN

FIG. 11



fice supply store, if you don't have some around. Flattened, they measure 2 3/4 inches long by 3/16th inch wide. Use a brand new one for fastest flow.

For the barb, you'll need a fish hook. Bronze colored hooks are tempered too hard and so are almost impossible to bend without breaking. Thus, the shaft behind the barb will be too long and also curved, or it will be too short to handle. The silvery ones can be straightened and so can be cut so the shaft rests on the hypo's needle end and the barb projects slightly beyond its tip as shown at the right of Figure 3.

From my Wal-Mart store I got a package of 50 FAST GRIP LIMERICK HOOKS, No. 2/0s. If you have no vise, hold the tying eye in a regular pliers and do the bending with needle nosed pliers.

To attach the barb to the needle, use ribbon epoxy. Liguid epoxy or plastic glue is messy and unreliable. Ribbon epoxy comes in a 14 inch, yellow and green strip. Cut off about 1/8 inch and knead it between your thumb and forefinger until it is thoroughly mixed. Wrap it around the barb and needle, as in Figure 4, and dispose of the excess. (DURO E*POX*E RIBBON is sold in most hardware stores for about $3.00. It sets in 2 hours and completely cures in 12).

For the mechanism (Fig. 5) which releases the rubber band, use a regular sized paper clip. Leave the larger bend alone and straighten the rest with the needle nosed pliers.

To hold the paper clip to the tube, allowing it to move freely, use a one inch length of plastic tubing which is thin enough to keep the paper clip from slanting. I use the plastic tubing cut from Q-Tips. these have cotton swabs at each end and are gotten at any supermarket in the beauty aids or baby section.

After putting the straight end of the paper clip through the tubing, use the needle nose pliers to bend the paper clip's end as in Figure 5.

For the cutter, a shred broken from a razor blade will do. But for uniformity and convenience I use the snap-off cutter blades which come with the razor knife (NT CUTTER A300), carried by, or ordered through most office supply stores. Another brand with snap-off blades is sold in most supermarkets. (These razor knifes are much better than X-acto Knives. As the tip dulls, another is there to take its place and since it is retractable by the thumb, it also mades a dandy anti-mugger weapon and it's legal to carry).

To attach the cutter (Fig. 5) prepare the same amount of ribbon epoxy as used to attach the barb to the needle. But instead of wrapping it around, simply lay the snap-off blade section down and put the large bend of the paper clip over it. Then press the epoxy on the blade and mold it so it connects with the paper clip as shown.

Next, position the cutter and tube on the hypo as shown in Figure 5. Then, put a strip of 3/4 inch wide plastic electrician's tape on the cutter tube and press firmly so the tape covers as much of the cutter tube as possible, then smooth it around the hypo tube.

After loading the hypo with poison, you'll want a large eye darning needle and about a foot of 12 pound plastic fishing line. Put about an inch of line through the eye and stick the needle through the cutter head, hypo tube, plunger, and out the other side as shown in Figure 6.

Tie tightly, hold it down at the join and tie a knot. Now all you have to do is carefully hold the hypo at the tube's end just beyond the cutter and pull the rubber band over the plunger so it rests across the clipped edges.

You can keep it so loaded for days before use but the longer you wait, the less tensile strength the rubber band will have. After two or three days, this would only mean that the plunger would take maybe half a second longer to empty the hypo. Even so, there's little reason to place the rubber band more than a couple of hours before use.

If a delay of several hours or days is necessary, dab a little vaseline on the needle tip to keep the poison from drying and clogging it.

Now for the carrier. (Fig. 8) It consists first of a 4 3/4 inch long tube to hold the Fang and another 3 1/8 inches long for the cover. However you want to measure the carrier tube, make sure the barb projects a bit over a half inch. If delivered by hand you'll feel a sense of assurance to know that the fish line will be cut and the back of the tube will start the plunger on its way just in case you neglected to cut off the last ring on the plunger's tip.

My holder is of CPVC plastic tubing, 7/8 OD (outside diameter). This can be bought from most hardware or plumbing supply stores for about $4.00 for ten feet. CPVC comes only in 5/8 and 7/8 OD and the 5/8 is too small. The aluminim tubing for the blowgun is 6/8 OD and therefore more compact. But the slight difference isn't important and you can't get the aluminum holder past a metal detector.

Whichever you use, make a circular cardboard plug to fit inside the tube, press a short length of the plastic tape on it, fit it inside the tube, as shown, and lap both ends of the tape over the outside. Then wrap one thickness of tape around the plug tape.

Next, wind more tape, starting 2 5/16ths inches from the bottom and

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Scientific American—July 25, 1861

Vent Stopper For Cannon

The most common cause of accidents with a cannon is the imperfect closing of the vent in loading. When a cannon is fired, pieces of the cartridge bag are frequently left in it on fire, but the smoke soon extinguishes them; if any atmospheric air, however, gets access to them they continue to burn, and when the cartridge is run down it is kindled, causing a premature discharge, which generally blows off the gunner's arm, and is very apt to kill him. To prevent this, a man is stationed at the vent to keep it tightly closed during the process of loading, but it seems to be almost impossible to teach men to perform this service thoroughly; hence the great number of accidents.

To secure a perfect closing of the vent in all cases is the object of the invention here illustrated. An elastic leather pad, A, is secured to the lower side of the lever, B, which is hinged to the breech of the gun in such position that, when it is turned down, the pad is brought directly over the vent. A hook or catch, C, is fixed to the gun on the side opposite the hinge, in a way to catch by a spring over the lever as the latter is turned down, and hold it securely in place with the pad pressed down upon the vent.

It would seem to be impossible for the most unskilled soldier to avoid closing the vent perfectly with this simple arrangement.

The patent for this invention was procured, through the Scientific American Patent Agency, May 28, 1861, and further information in relation to it may be had by addressing the inventor, J.J. Hirschbuhl, at Lousville, Ky

to a thickness of about 1/16 inch. This is to keep the cover from touching the barb.

For the cover, use two strips of regular typing paper 2-1/8 inches wide. Wrap one strip snugly around a piece of the holder tubing and spread glue along its width. Then finish wrapping the first strip, glue it down and do the same with the second strip. This will give the cover its proper thickness. Slip it off the tubing and make a plug in the same way as for the holding tube. That's all there is to that.

The only difference in the Fang when you mean to use it in a blowgun is the propelling shield, without which you'd just blow it out onto the sidewalk. For this, cut a 5/8 inch circle of corrugated cardboard. (Fig. 7). You can also get 5/8 inch plastic buttons from the local sewing shop which will serve as well.

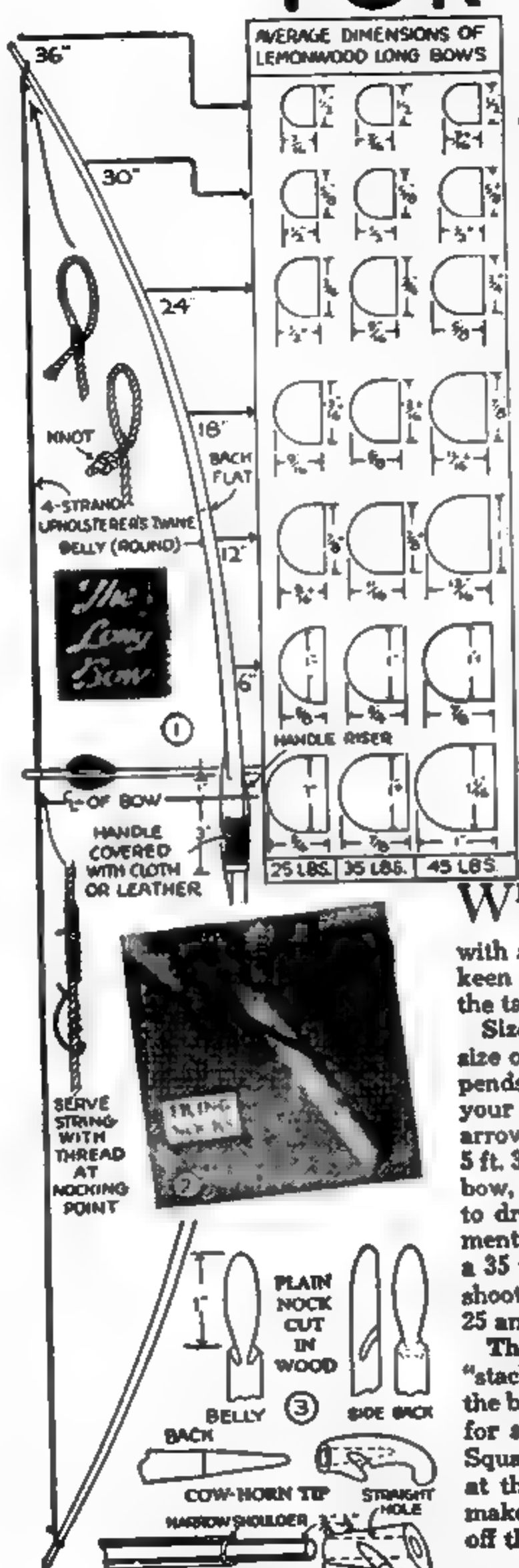
With your darning needle and thread, sew the cardboard or button to the other end of the rubber band with three or four stitches. When pulling the rubber band back over the plunger, don't pull it by the cardboard or button. Instead, use a knife or similar flat instrument under the rubber band and ease it over the plunger.

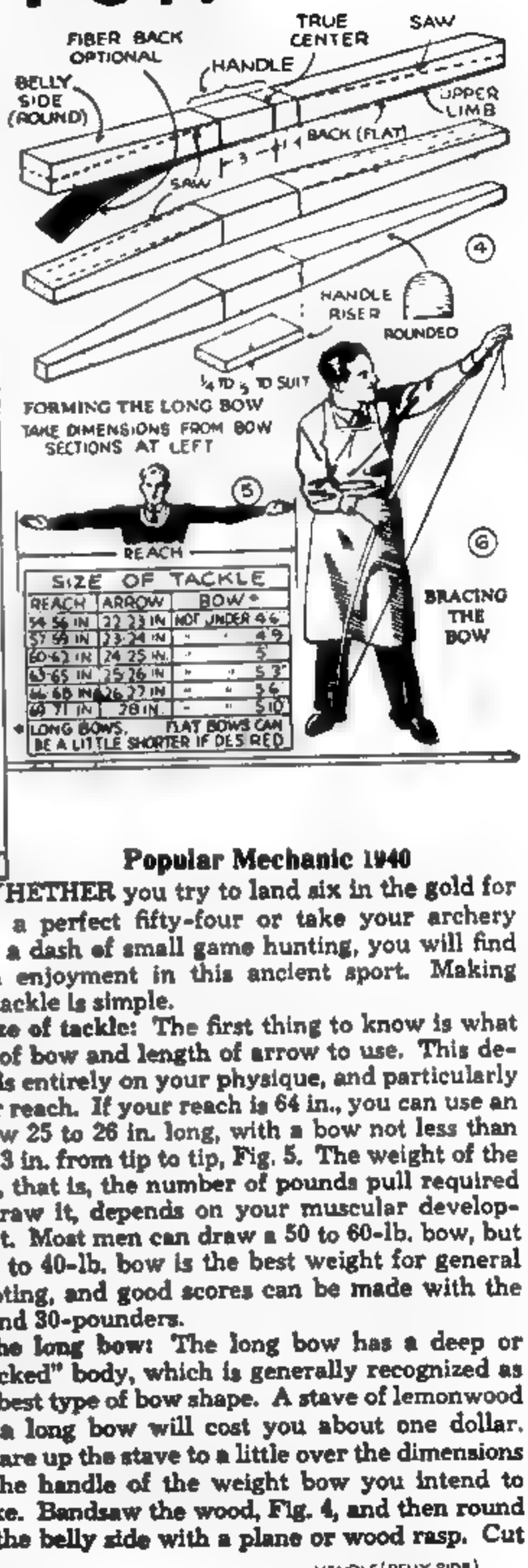
For the blowgun, (Fig. 10) you will need about five feet of 6/8 OD aluminum tubing. I got mine from the manufacturer here in Harrison so I don't know how common that size is in other areas. By calling around, however, you should find a source.

Commercial blowguns have mouthpieces but I can't tell the difference between using one with and one without a mouthpiece. But if you must have a mouthpiece you can easily make one (Fig. 9) with plastic-backed rubber tape from your hardware store. This tape sticks only to itself and I think it's used for sealing plumbing joints.

To make the mouthpiece, wrap the sticky side of the rubber tape, after removing the plastic, around one end of the tube. As you wrap, gradually layer it further from the end of the tube, as shown. When you have it wide enough and deep enough to fit your lips in comfort, cut the tape and smooth it down and you'll have as good mouthpiece as any you can buy.

SHOOT A BOW FOR FUN





SIZE OF TACKLE		
REACH	ARROW	BOW*
54-56 IN	22-23 IN	NOT UNDER 46
57-59 IN	23-24 IN	" " 49
60-62 IN	24-25 IN.	" " 52
63-65 IN	25-26 IN	" " 53"
66-68 IN	26-27 IN	" " 56
69-71 IN	28 IN.	" " 510

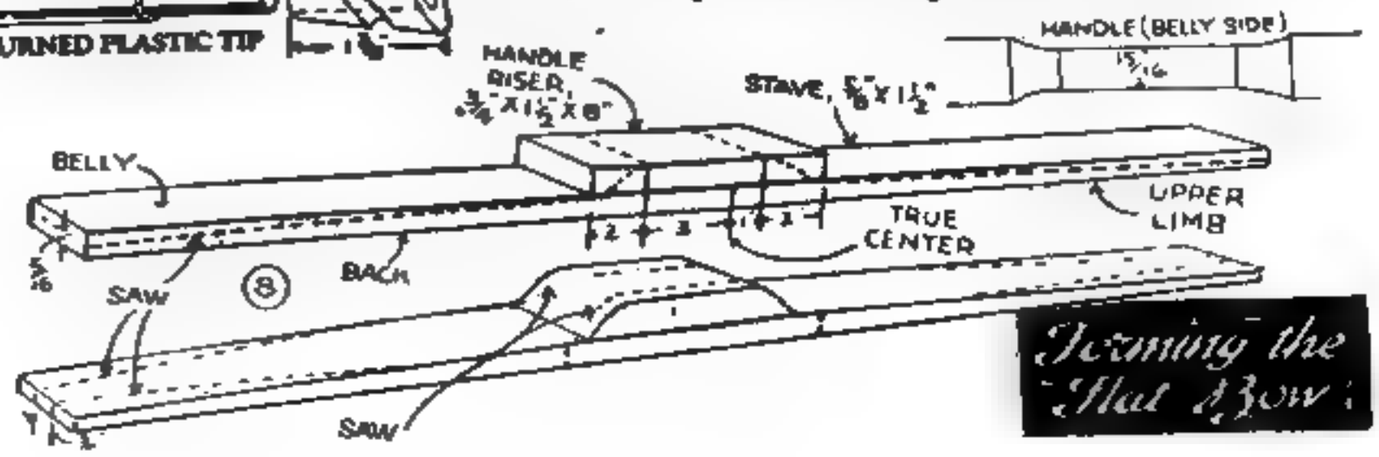
* LONG BOWS. FLAT BOWS CAN BE A LITTLE SHORTER IF DESIRED

Popular Mechanic 1940

WHETHER you try to land six in the gold for a perfect fifty-four or take your archery with a dash of small game hunting, you will find keen enjoyment in this ancient sport. Making the tackle is simple.

Size of tackle: The first thing to know is what size of bow and length of arrow to use. This depends entirely on your physique, and particularly your reach. If your reach is 64 in., you can use an arrow 25 to 26 in. long, with a bow not less than 5 ft. 3 in. from tip to tip, Fig. 5. The weight of the bow, that is, the number of pounds pull required to draw it, depends on your muscular development. Most men can draw a 50 to 60-lb. bow, but a 35 to 40-lb. bow is the best weight for general shooting, and good scores can be made with the 25 and 30-pounders.

The long bow: The long bow has a deep or "stacked" body, which is generally recognized as the best type of bow shape. A stave of lemonwood for a long bow will cost you about one dollar. Square up the stave to a little over the dimensions at the handle of the weight bow you intend to make. Bandsaw the wood, Fig. 4, and then round off the belly side with a plane or wood rasp. Cut



You may want to carry your blowgun around with you in a briefcase, or shopping bag, depending on your station in life. If so, you'll want a take-down model which comes apart in sections.

The standard blowgun is around 54 inches long. So cut your tubing into three 18 inch lengths. (Fig. 10) With an electric grinder or a file, take off the edges of the ends so they slope. This makes it easier to fit the sections into their holders.

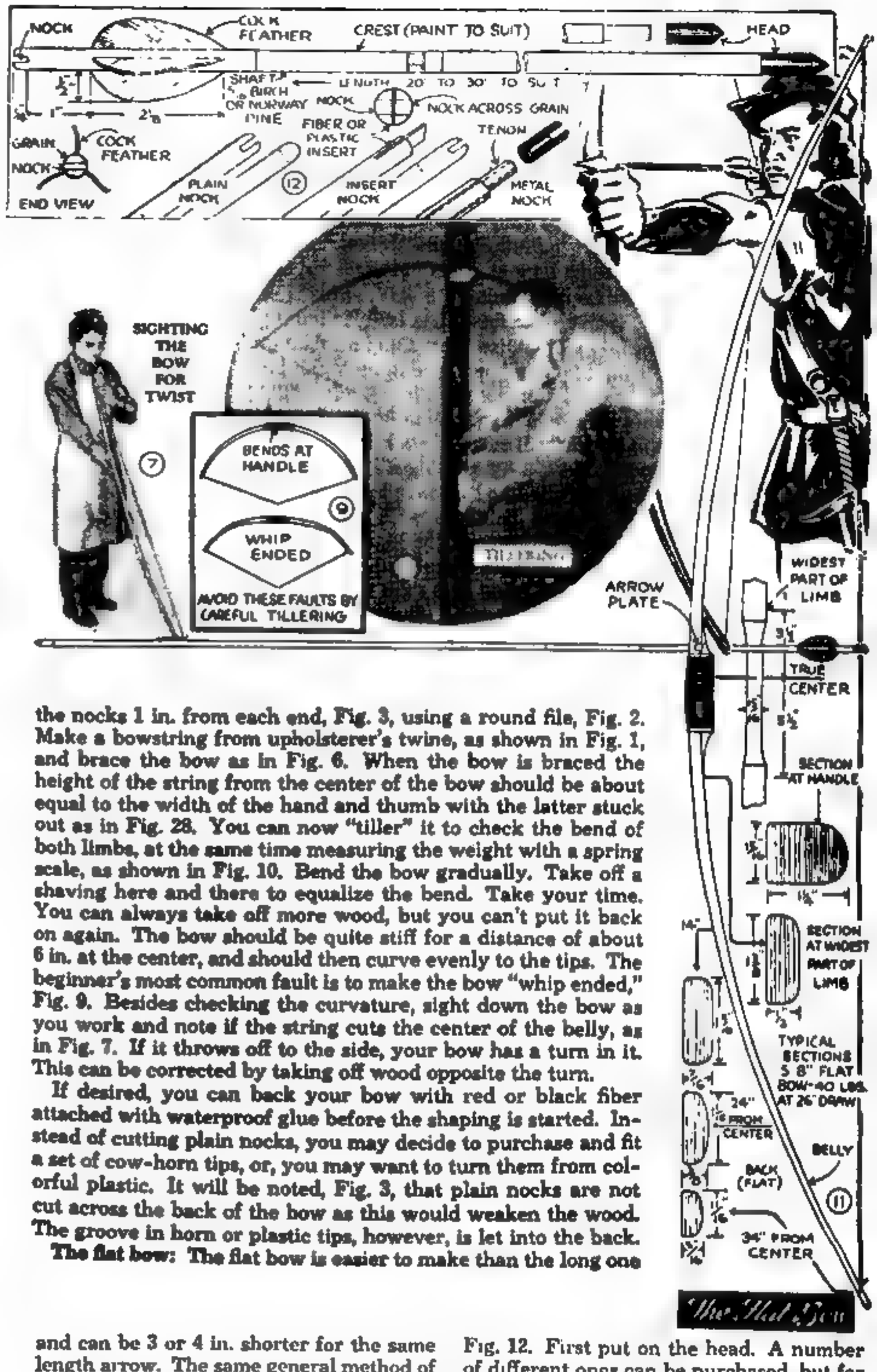
As in Figure 11, cut two 1/8 inch rings from the scrap tubing to fit in the middle of the holders. This allows you to automatically push each section an equal distance to the middle. With a round file or sharp knife, ream out any rough edges or burrs from the inside edges of the tubes and rings.

If your only purpose for having a blowgun is recreational, a simple, layered paper tube is enough. It is also enough if you expect pretty good light to assemble it by.

In this case you'll need six or more 4 inches wide by 11 inches long strips of typing paper or that from a paper sack. Lay a section of tubing on a strip and roll the tubing and paper away from you. Put a line of ELMER'S GLUE-ALL, or similar brand of fast drying white glue across the edge of the paper facing you. Make it as snug and as straight as you can. When the glued edge contacts the paper further on, begin correcting for straightness and snugness. As the roll nears the end of the strip, put on some more glue and proceed until you have it about 1/8 inch thick, or more. The proper thickness will insure the blowgun's straightness and hense, its accuracy.

When two such rolls are made, ease the rings in and push them further with the lengths of tubing. You might mark the tubing 1 15/16 inch from the end so you'll know that when both tubes are in place, the ring is exactly in the middle. Then remove the tubing, turn the paper roll up and toward you and glue the ring using one of the Q-Tips swabs. With the outer edges of the tubes ground down, it is easy to fit them into the rolls in good light.

If you expect to be working in very dim light, you'll need flared ends for the section holders so you can assemble the blowgun by feel. Since



the nocks 1 in. from each end, Fig. 3, using a round file, Fig. 2. Make a bowstring from upholsterer's twine, as shown in Fig. 1, and brace the bow as in Fig. 6. When the bow is braced the height of the string from the center of the bow should be about equal to the width of the hand and thumb with the latter stuck out as in Fig. 28. You can now "tiller" it to check the bend of both limbs, at the same time measuring the weight with a spring scale, as shown in Fig. 10. Bend the bow gradually. Take off a shaving here and there to equalize the bend. Take your time. You can always take off more wood, but you can't put it back on again. The bow should be quite stiff for a distance of about 6 in. at the center, and should then curve evenly to the tips. The beginner's most common fault is to make the bow "whip ended," Fig. 9. Besides checking the curvature, sight down the bow as you work and note if the string cuts the center of the belly, as in Fig. 7. If it throws off to the side, your bow has a turn in it. This can be corrected by taking off wood opposite the turn.

If desired, you can back your bow with red or black fiber attached with waterproof glue before the shaping is started. Instead of cutting plain nocks, you may decide to purchase and fit a set of cow-horn tips, or, you may want to turn them from colorful plastic. It will be noted, Fig. 3, that plain nocks are not cut across the back of the bow as this would weaken the wood. The groove in horn or plastic tips, however, is let into the back.

The flat bow: The flat bow is easier to make than the long one and can be 3 or 4 in. shorter for the same length arrow. The same general method of bandsawing is used, Fig. 8, but the belly side is only lightly rounded off. Typical sections of a 40-lb. flat bow are given in Fig. 11. The handle riser can be the same or of a contrasting wood to the bow itself. The narrow plate, which prevents wear, is inlaid, using a 3/16-in. disk of 1/16-in. plastic.

Self arrows: A "self" arrow is one made from a single piece of wood. The simplest way to make self arrows is to buy a construction kit, which includes the 5/16-in. dowel sticks, feathers and heads. Birch is the best wood to use. The various parts and dimensions of the arrow are shown in Fig. 12. First put on the head. A number of different ones can be purchased, but for average target work the brass parallel pile head is most satisfactory. Cut the tenon on the end of the shaft by turning on a lathe, Fig. 14. If you are careful, the head will be a drive fit and will hold securely. If the head is a bit loose, anchor it with a few punch taps as shown in Fig. 16. Cut the arrows to the required length and then cut the nocks. Plain nocks can be cut easily by running the shafts over a circular saw, as in Fig. 13. The nock should be across the grain. If you want more strength at the nock, insert a thin slip of fiber or plastic. Aluminum or molded-plastic nocks are

you've already got the ribbon epoxy you might as well use it for the section holders too.

First, using an electric grinder or sandpaper, grind the edges of the section holders back in a slope 1/4 inch from the ends. Knead 5 inches of the ribbon epoxy and roll it into a cylinder. Cut it into four equal pieces. Roll each part to 2 3/8 inches long and press to about 1/2 inch wide and 1/4 inch from the ends. With the first, or index finger inside the holder, use the thumb to press and flare the ribbon epoxy as shown in Figure 11.

After the sections have set 12 hours they are ready to use. The flared ends will enable you to put them together by feel.

SAXON'S HAND FANG

The Hand Fang is only for the delivery by hand of poisons. Although the Ultimate Fang can be used and delivers 2 ccs surely, it is harder to make and is gone, as the police simply will not give it back. Therefore, I would restrict the Ultimate Fang for distance and use the Hand Fang for close-up work.

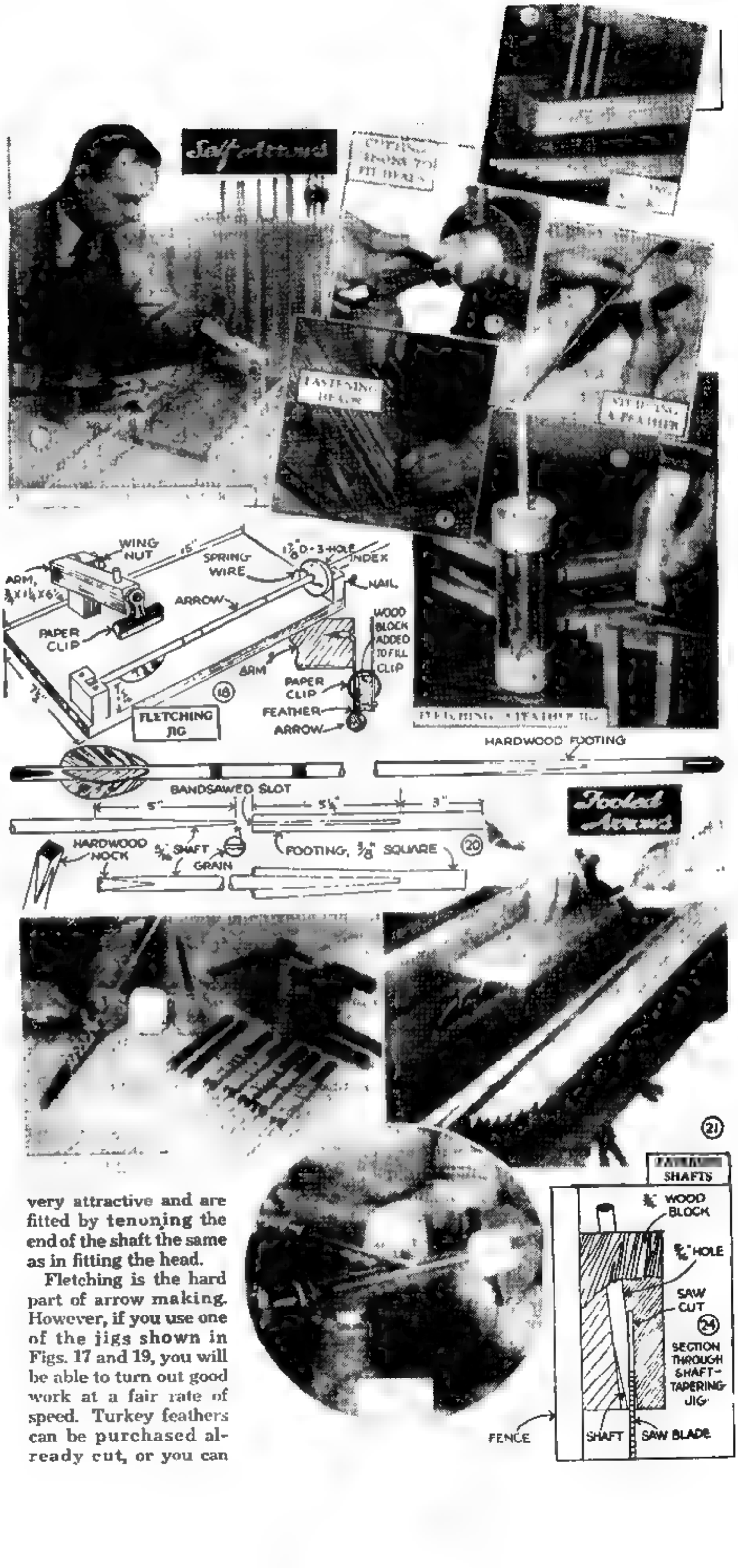
When you make your Hand Fang, test it through a cardboard box. A quick thrust will empty the needle by the harder pressure on the plunger. Unless you meant to, you'd be hard put to remove it before it was empty.

One cc of any of the poisons following this article is plenty. Also, your opponent's reaction time would prevent leaving the needle in for the full 2 cc load.

Unlike the Ultimate Fang, the Hand Fang takes little effort to make and its holder is made exactly the same way as that for the Ultimate Fang. (Fig. 8). It is simply scaled down so that its holding tube is 3 5/8 inches and its cover is 2 1/2 iches in length.

The hypo's needle is cut and reground, the finger holds are removed and the end of the plunger is trimmed all the way around to fit into the CPVC tubing.

Since it takes more pressure to push the plunger in using the Hand Fang, the plug should be cut from a wooden dowel or plastic and glued in Even better, a 7/16 inch diameter faucet washer from the hardware store pounded into the tube is permanent and will never come out with normal use.



very attractive and are fitted by tenoning the end of the shaft the same as in fitting the head.

Fletching is the hard part of arrow making. However, if you use one of the jigs shown in Figs. 17 and 19, you will be able to turn out good work at a fair rate of speed. Turkey feathers can be purchased already cut, or you can

A hole is burned or drilled all the way through the end of the tube 1/2 inch from the back, as shown at the right of Figure 7, so it also goes through the plunger. An L shaped wire cut from a paper clip is thrust through so the bottom of the L stays outside. This is held in place by a layer of tape wrapped around the tube's end. This holds the plunger in the tube permanently.

When loaded with 1 cc, the needle projects slightly more than 1 1/2 inches from the tube and 5/8 inch when empty.

to load, use the needle nosed pliers, put the needle tip into a shallow container of poison and with the pliers holding the needle, simply pull out the hypo until the first black line is visible. The best way to load the Hand Fang is with a vaccine bottle. Upend the bottle and stick the needle through the rubber until you can just see its tip. With the needle nosed pliers, pull up the needle until you can see the black line and you'll have 1 cc and you'll be all set.

POISONS

The most glamorous and popular poison is potassium cyanide. You can order it from several of the chemical suppliers listed in this volume.

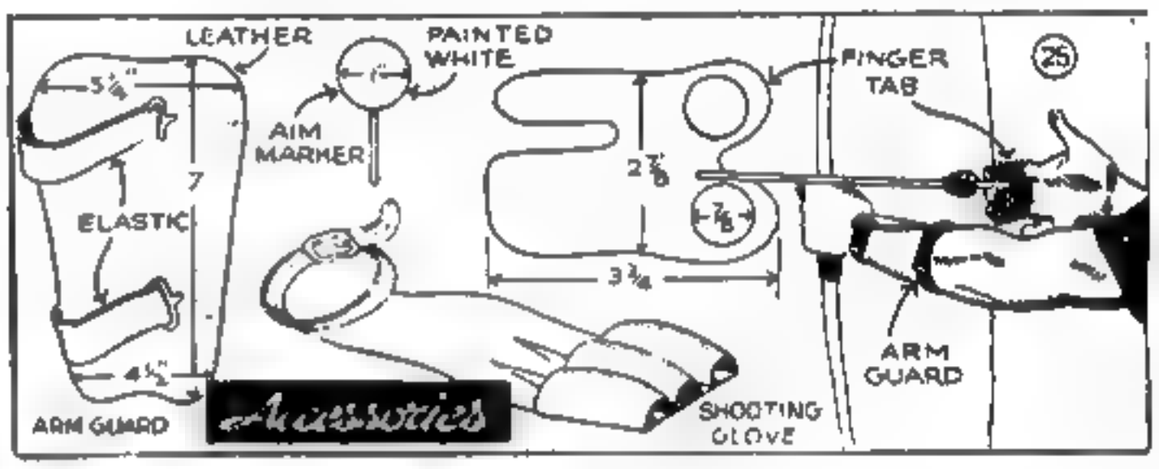
To make it most potent for injection, put 1/4 ounce in one oz. water and stir until it dissolves. Shake in more and stir again. Keep this up until some stays on the bottom undissolved. You now have a saturated solution, meaning the clear liquid is as strong with cyanide as it can get.

One quarter cc should do the job, but why be stingy? Give your opponent the full 2 ccs as a show of generosity.

The cheapest and most convenient poison, however, is simple nicotine. It can be gotten in the form of Black Leaf 40, an insecticide. It is sold for about $3.00 for 2 oz. of 40% pure nicotine in most garden sections of supermarkets or in plant nurseries. It

strip your own feathers by grasping the vane at the tip and pulling outward, as shown in Fig. 15, afterward cutting the vane to the required shape. The one-feather fletching jig shown in Figs. 17 and 18 is built around a paper clip. A disk of plywood, which slips over the shaft, is drilled with three small holes to supply an indexing head, and is prevented from slipping by means of a piece of spring wire. One feather at a time is clamped by the paper clip and pressed into position. Any type of adhesive can be used. Celluloid cement has the advantage of quick drying and the ability to anchor on lacquer, thus allowing the shafts to be painted previous to fletching. Waterproof glue on bare wood is the most durable. In the three-feather jig, the feathers are held between metal plates, one plate of each set fitting into grooves in the top and bottom members. The upper ring is removable, being a press fit over the three spacing dowels.

Footed arrows: Footed arrows are more decorative and more durable than self arrows. The footing is made from any tough hardwood, and is slotted for a distance of 5¼ in., Fig. 20. Shafts are usually Port Orford cedar or Norway pine, and are tapered to fit the slot in the footing. Perfect tapering of the shafts can be done by the circular-saw method shown in Figs. 21 and 24. The taper should be made with the flat of the grain. The shaft is assembled to the footing with waterproof glue and the assembly is then clamped or wrapped with twine or rubber strips as in Fig. 22. Other than a special tenoning jig, the best method of rounding the footing to match the rest of the shaft is by turning, Fig. 23. Nocks



for footed arrows are usually of the same wood as used for the footing. The insert is let into the end of the shaft, and is later rounded off and grooved in the usual manner.

Accessories: If you want to be comfortable while shooting, you will need an arm guard and a finger protector. Any kind of leather band around the wrist and forearm will do for the guard, its purpose being to take the lash of the bowstring as the arrow is let loose. A simple finger tab of soft leather shaped as shown in Fig. 25 will provide protection for your fingers, or you may prefer to make or buy a three-finger shooting glove. An excellent target can be made by cementing four or five layers of corrugated cardboard together, painting the rings directly on the cardboard or on a piece of oilcloth. A simple target stand is made from ¾-in. lumber, as shown in Fig. 27.

How to shoot: Stand with your feet well apart, left side facing the target, as shown in Figs. 26 and 29. Hold the bow horizontal and fit an arrow across the arrow plate. Grasp the arrow with the thumb or first finger of the left hand, Fig. 30, and with the right hand twirl the arrow until the cock feather is perpendicular to the bowstring. Adjust your grip on the string, as shown at the right in Fig. 25, and start the draw. Pull back slowly until your right hand comes to a fixed "anchor" point on your jawbone, Fig. 31. In this position, the string should be under and in line with the right eye. Aiming is done by sighting over the tip of the arrow to some fixed point previously determined as the correct point of aim at the distance being shot. Fig. 32 illustrates this method of aiming.

is sold all over the Free South. Yankees and Californians can't get it because too many of them are simple and so can't be trusted with such substances. You might look for it anyway, in case I'm wrong about your specific area.

The fatal dose of pure nicotine is about 40 mg. (1 drop, 2/3 gr.), a quantity contained in 2 Gm. (30 gr.) of tobacco (2 cigarettes).

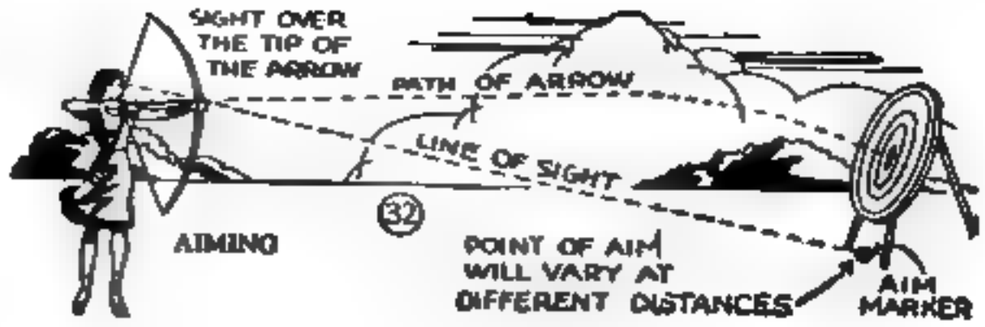
To get your own nicotine, I recommend buying a can of Copenhagen or Skoal tobacco, sold in most grocery stores. Saturate the tobacco with water, put on its lid and let in alone for 24 hours or so. Then put the soggy mass on a cloth and twist out the liquid into a small jar. Next, pour it through a coffee filter to make sure there are no particles of tobacco which might clog the needle.

A hypo filled with 1 cc of this will do the job as surely as a round from a 44 Magnum.

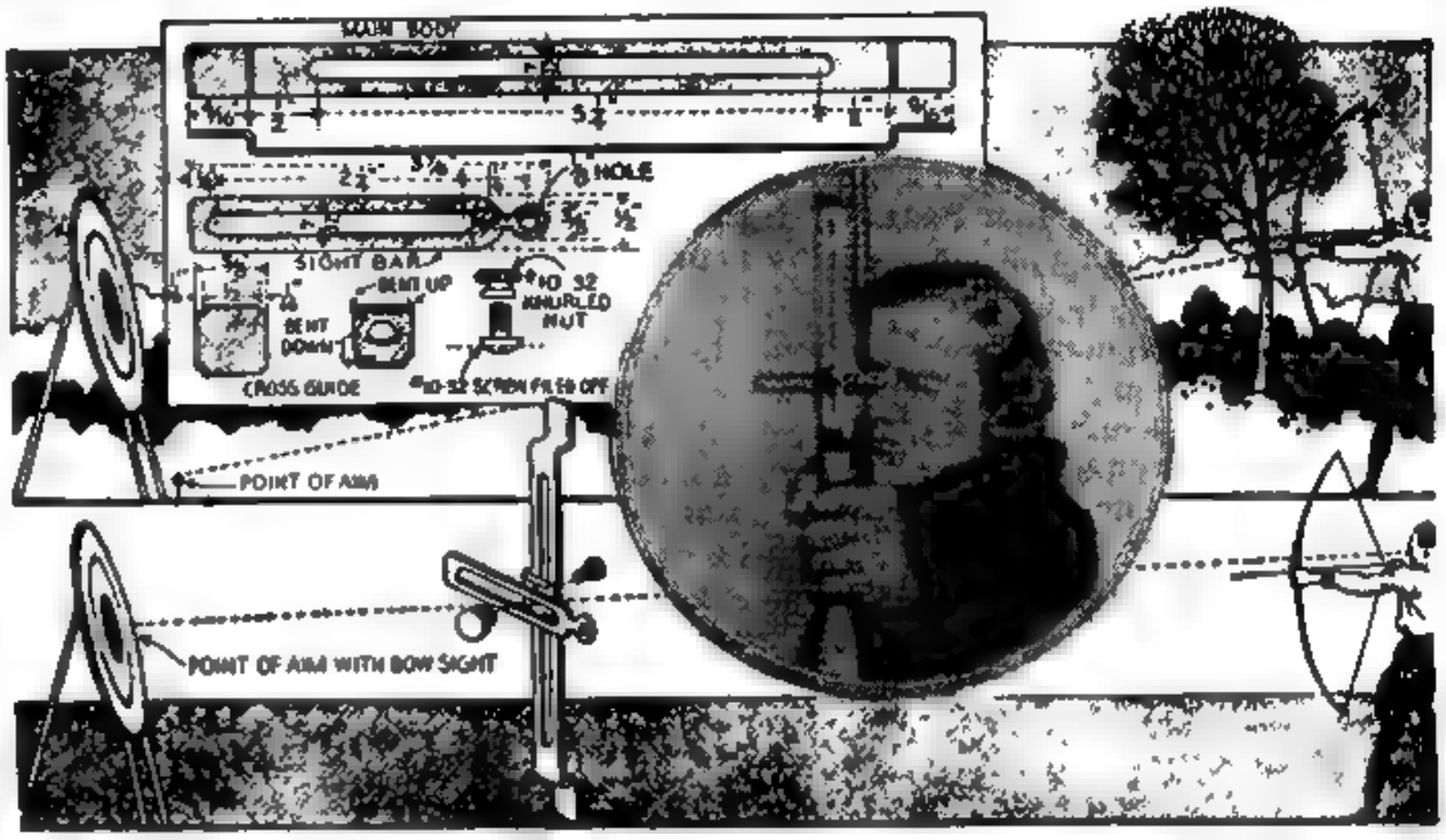
An excellent use for the Hand Fang is the injection of ricin. The Russian who stabbed the Belgian with the umbrella tip loaded with a tiny hollow metal ball filled with ricin was a clumsy jerk. He was recognized and the weapon was known. Had he used the Hand Fang, a quick thrust and all the Belgian would have known was that he'd been stuck with something but the weapon would have been concealed so fast that he'd never be sure what really happened or if the Russian had really done it.

Ricine is best used in situations where you want to be well away before your opponent shows any signs of wear. This would involve a person you know and who may know you. You don't want him to drop dead while you're anywhere in the vacinity lest a connection be suspected. But if you're at a party or in a bar where he is and someone gives him a playful jab with a pin, what's to prove if he starts going to hell hours or days later?

So a good rule of thumb is; if no connection is known, you can drop him like a hot rock and join the gawking bystanders. You might even comment to listeners on the dangers of junk foods. But if you know him or if you are obviously political or social opposites where his destruction would reflect on you, use ricin.



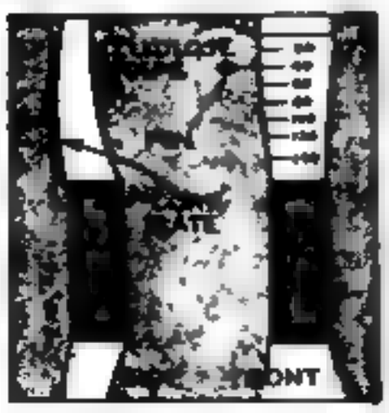
Sight on Archery Bow Improves Your Aim



Taped to your archery bow, this adjustable sight will be found a more satisfactory method of shooting an arrow than the "point-of-aim" method, as you aim right at the bull's-eye instead of sighting at a marker on the ground in front of the target. Thus, any variation in bowing or in distance is not likely to affect your aim. The parts of the sight are made of heavy sheet steel or brass and are cut to the shape and sizes given in the detail. When finished, they should be polished with fine emery cloth or steel wool. Nickel or chromium plating will improve their appearance. The sight is mounted on the back of the bow with the sight end of the cross bar extending to the left. It is adjustable either vertically or horizontally. Once set for a certain shooting distance, the sight may be marked so that when the same distance is shot again, the correct adjustment can be made without any trouble.

A Versatile Homemade Bow Sight

This simple, lightweight device has all the adjustable variations of an expensive bow sight, and with an average weight bow is fairly accurate for distances well over 100 yards. Cut from a strip of cork gasket material 1 in. wide by 6 in. long, the sight is fastened with adhesive tape to the back of the bow just above the leather grip. After gluing the cork in place, put a strip of cellulose tape on the belly of the bow opposite the cork. Stick a 2-in. round-head hat pin into the cork so that the head projects ½ in. beyond the left edge of the bow. Then, by the trial-and-error method at various distances, determine the proper position of the pin for each distance and mark these positions in ink on the tape, numbering them accordingly. A coat of clear shellac will protect both the cork and the scale.



Making Arrows Visible

To locate your archery arrows easily after shooting them, wrap bands of tinfoil on the shafts just in front of the feathers, and shellac the bands to prevent tearing. The tinfoil will glisten in the sun so that an arrow can be seen at a distance of many yards. This method is especially effective in cases where the arrows happen to fall in tall grass, weeds, etc.

ROAD BLOCK

By KURT SAXON

I'm sure you've seen movies and TV shows where road blocks are put up and the villain or hero crashes right through and gets away. This is for effect, as decently equipped police departments have portable road blocks studded with over sized spikes. For P.D.s who can't affort these or need to stop traffic immediately without calling in, you can't beat my tire shredding road blocks. They can also be used by civilians to teach trespassers the error of their ways.

All you need for 10 tire shredders is two boxes of mower blades used for hay, wheat, oats, etc., bought at any farm supply store. They come in boxes of 10 for under $5.00. Two boxes will give you 10 shredders which, after brazing, shouldn't cost more than about $25.00.

They are extremely portable as all 10 will fit into a space smaller than shoe box.

If you don't have welding gear, take them to your nearest welding shop. The blades should be placed flat side down and those used as shredders held straight up in the middle. They must be brazed as they are made of tempered steel and if simply welded, will snap under pressure. Braze all along both sides and paint whatever color you want. Before painting, grind the ridge off the top side so you'll have a razor sharp edge.

If you are a cop you might paint them fire engine yellow so maybe your quarry will see them and stop. If you are a civilian you'll want them to blend in with the road you are using to trap someone.

To use, place them in a line across the expected route of the quarry with the pointed ends on the bottom facing traffic. This will shred any tire under three inches thick, which would stop just about any vehicle on the highway, including Army trucks.

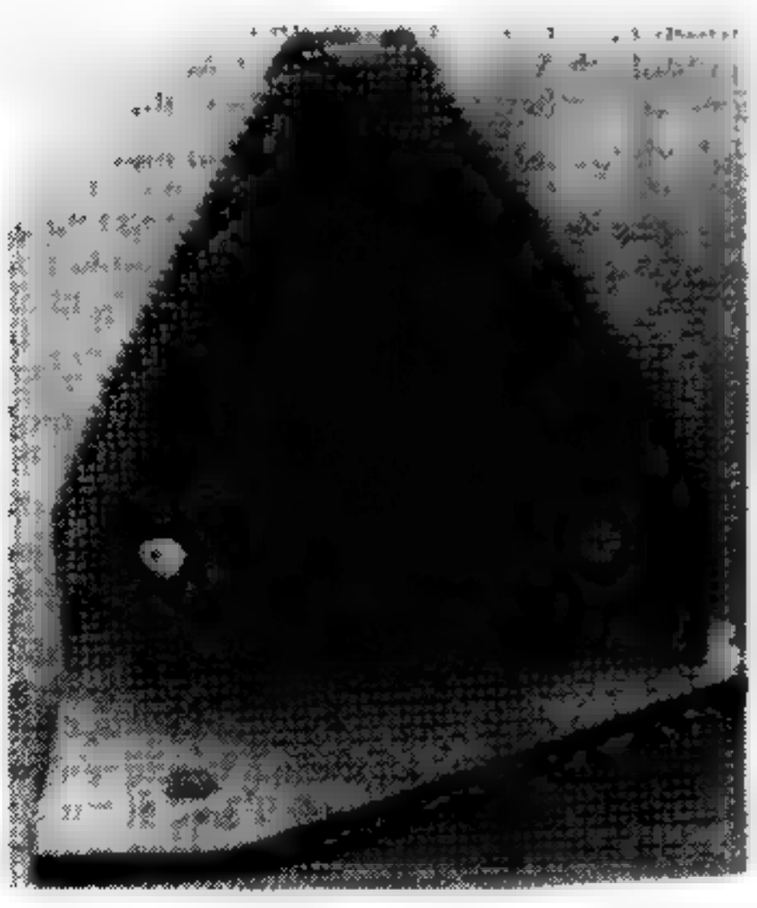
These shredders are suggested for protecting your property from people who trespass just for the hell of it, to steal or to attack you. Unlike nails, which may not take effect for several yards, or even a mile or so as the air leaks out, the shredders cut through tires as if they were butter. The result is immediate and the quarry is demoralized and at your mercy.

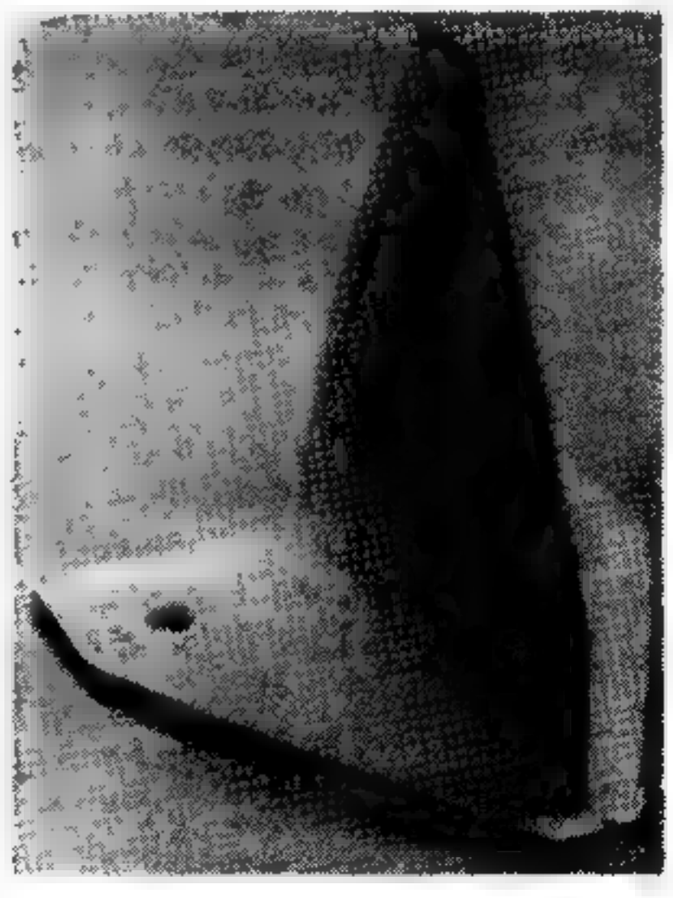
Of course, for a civilian to put such devices on a public highway for just anybody to run over would be a criminal act and totally without class. Try not to be any more of a slob that you are. Cops must realize that since the effect is immediate and more dramatic than a nail or a simple blowout, control is gone, especially at speed.

As far as legality goes, on your own property, you must have a prominent "NO TRESPASSING" sign near a sign with your name on it. For instance, I have a big sign at the bottom of my property saying, "SAXON'S LAIR" under which is "DEAD (skull and crossbones) END."

This way, anyone who can read knows I don't want anyone around who has no business here. Even so, people will still come up looking for "Charlie", "Burt", "Clem" or whatever or they are lost tourists or delivery persons. So I only put out the shredders after dark, when the day's work is over and people aren't wandering around sightseeing.

You see, I don't want to destroy anyone's tires unless he's really asking for trouble. But after dark, anyone coming on my property unannounced is asking for it. I can legally put anything on my off-the-highway driveway I want, so long as it doesn't threaten life.





"Barbarians of the World Unite — You Have Nothing to Lose But Your Parasites!"

KURT SAXON

This editorial by the late John Campbell may be the most important one in all my works. It addresses itself to most of you and should help you to sort out a lot of the conflicts we barbarians have concerning our place in society.

John Campbell was a citizen type, a trained scientist and a major contributor to the field of science fiction. This editorial was taken from the August, 1964 edition of Analog.

As a citizen type, although John had barbarians sized up more accurately than any writer I've read, he was biased. He lumped para, average and sub-barbarians all in the same category. Nor did he see the necessity for the Para-barbarian in the transition from our foundering civilization of today to the culled and strong civilization of tomorrow.

My next editorial will put you in the picture. In the meantime, read John's editorial over several times.

the barbarian menace

John Campbell

■ A few months back I discussed here the effect that marching, countermarching, and round-and-round marching barbarian armies had had on human history. They provided Mankind with one of those great "educational opportunities"—education on the "Learn—or drop dead!" basis. This educational technique does not, of course, help the individual greatly, nor is it ever popular with the educatee, his group, or his descendants.

But education is a very strange thing. Everybody wants to *have* one, but the resistance to getting one, or having one forced upon you, is remarkable, considering how highly the thing is regarded. Practically everyone is certain that more education is just what the other guy needs to be given—but the wish for personal education is almost invariably of the form "I wish I had had . . ." The pluperfect tense—not the present-intentional, or the immediate-future tense. It's much more popular to sigh about the fact that education didn't happen years ago than to do something about getting it now.

Education is something everyone wants in his past—and is resisted from "stubbornly" to "violently" in the present. "I haven't the time, now . . ." is the standard excuse. Neither does a ten-year-old; just ask him. He has all those ball games to take care of, and the fishing to attend to, and a great many other important things that he needs to do. It's only that he's enslaved* by adult task-masters that forces him to acquire what he doesn't want.

*One of the commonest definitions of slavery is "being forced to labor at tasks not of your own choosing, under threat of physical punishment, while being unable to escape. If the slave escapes, he will be arrested and forcibly returned to his master." The child is enslaved!

While people look back on those horrid, awful, wicked times with loathing . . . they are enjoying the benefits conferred on us by those barbarian tactics. The barbarian armies culled out those individuals who could not learn—who did not have the flexibility that made possible a reorientation in adult life. Any cub, pup, or child can learn a new way of life; they obviously have to, for any way of life is new to them. The far more difficult thing is to learn a different way of life after you've learned one—for the Old Dog to learn new tricks. For the individual brought up as a Christian to be able to learn the new set of values the Moslem army insists on—or for the brought-up-Moslem individual to learn the values system of the Crusaders-with-swords.

This is, of course, a highly effective selective breeding system—whether the barbarian armies so intended it makes no difference whatever. It selectively bred for the characteristic of educability-and-flexibility in the descendants of the conquered peoples. And inasmuch as *no* people ever remained permanently unconquered, every group in the marching-barbarian-armies system was, repeatedly, in the class "conquered" often and long enough to be repeatedly and thoroughly culled over for elimination of the uneducable.

Please note carefully: I'm *not* saying "This is the way it should be; this is what I recommend!" I'm saying "This is in fact what observably happened."

We hear a lot of yak about behavior

characteristics, mental and phychological characteristics, not being genetically heritable. This is absolute, and completely stupid nonsense; watch the courting patterns of various birds, for instance. Or the behavior of salmon in returning to their native stream. The migration patterns of hummingbirds, or the nest-making pattern of the paper-making wasp. Each displays very specifically inherited *behavior* patterns—not merely physiological patterns.

In bees, there is an additional inherited-pattern system demonstrated; a given fertile egg can be developed into a sexless worker if fed in one way, or into a queen, if fed a different diet. Here, both physiological and behavioral patterns are seemingly determined by the diet.

Obviously, they're not; the diet doesn't carry that much information! It's a lot closer to having a record that, played one side up produces the pattern "The Pines of Rome," while, played the other side up, displays the sound-pattern of "Hungarian Rhapsody." There is, in the bee egg, a dual potential; which potential is developed into activity can be influenced—but the potential itself is genetically determined.

What we need at this point is a somewhat more precise meaning of the term "barbarian." The origin of the term stems from the old Greek conviction that anyone who didn't speak Hellenistic Greek was less-than-human—that the aliens didn't really speak, any more than dogs or chickens did. They just made mouth noises like *bar-bar-bar*, and were called *barbarians*.

So the original meaning of the term was simply "Somebody who doesn't speak Hellenistic Greek." This means the world today is populated entirely by barbarians.

Later, it meant "Any people whose culture and ways of life I disapprove of—that is, anyone who doesn't live The Only Right Way—my way!"

That's a very minor modification of the Greek meaning. It did, however, allow that someone who spoke perfect

The Citizen Menace

By Kurt Saxon

Within every organism, from the amoeba to man lies the inherent urge to develop and express all its positive traits. Normally, organisms whose negative traits predominate are culled by the environment.

In Man, pre-tribal savage groups culled those with predominantly negative traits by killing or driving them away. Except in the best of times, even those who were physically strong and mentally healthy had a difficult time staying alive. A weakling or dimwit could neither gather enough food nor defend the group. Any weakness of the individual was a threat to the group's survival.

In time, some animals and plants were domesticated. The resulting surpluses permitted the keeping alive of some who were less than adequate to the rigors of savagery. This marked the birth of tribalism.

Under the hardships of savagery, the only positive traits a man could develop were those which simply made him a better hunting animal. Tribalism, with its basic organization and cooperation, could have brought about the development of the higher traits we value in individuals of accomplishment.

But under tribalism, the development of superior traits among individuals was discouraged in favor of conformity to group dictates. Such dictates were usually for the benefit of the chiefs and the priesthood.

If a superior tribesman could carry out his duties better than his peers, he was honored. If, however, he sought to introduce progress beyond the capacities of the group, he was considered a threat. Ideas demanding higher intelligence to implement threatened the value of the less intelligent. Also, those in authority wanted a system only they could manipulate and control. If the ideas of the superior individual demanded the selection of more intelligent people, the leaders were threatened. So under tribalistic dictatorship, higher individual traits went undeveloped, lest the people become independent of their mediocre rulers.

An important sidelight to the development of social structure and the repression of individual development, was organized religion. The savages' angry storm gods and gods of the hunt were largely replaced by tribalists' fertility gods. Rituals placating and serving these gods marked time between planting and harvesting. As the approaching seasons came to be marked by stars, the Earth gods were kicked upstairs where they watched over everything from "Heaven."

As tribalism and religion developed, traditions and taboos largely replaced nature as the culling agent. The traditions and taboos were mainly to insure that the work got done. Those who did not follow tradition and broke taboos were gotten rid of. It would be a long time before written records and intelligent observation did away with the need for tradition, and all the gods ever dreamed up could be replaced by an almanac.

Under tribalism, individual responsibility was neither encouraged nor wanted. Harmony and a continuation of a system that worked for the group was dependent on obedience. Tradition and religion governed every action. Under such a system, there could be no individuality, thus no innovation, hence, no progress.

Enter the barbarian. I like to think that in most cases he was one with a mind of his own who refused to take orders from superstitious, tradition-bound fools. He would not drudge from sunup until sundown with no expectation of personal reward or advancement. If he lacked creativity it was probably because the system stifled it.

Having been driven from the tribe because of nonconformity, he probably

Greek could be a barbarian. This meant that, as any Athenian could clearly recognize, Spartans were barbarians, even though they did speak Greek.

To a very large extent, the term "barbarian" is used today in precisely that way; it has no precise meaning, and is solely a term of disparagement, a term of insult.

I want to make a precise definition of the term, one that will make it useful in discussion—which no vague, variable-referent term can be.

Let me hasten to point out that vague, variable-referent terms can be extremely *satisfying* in discussion; they simply aren't *useful*. That is, if we have "barbarian" as a vague, variable-referent term meaning "someone whose manners, customs, appearance, language, or values I dislike because they are unlike mine," then if I say, "I don't like that man," and you ask me why, I can, with satisfying sense of conviction and completion, say "Because he's a barbarian!"

This is very satisfying; it gives one the impression he has said something meaningful in explanation of his dislike. That he has made a profound, and definitive statement. It's satisfying.

It's also perfectly circular. "I don't like him because he acts in a way I dislike."

Let's try something more definitive, and acultural—use actual, observable behavior characteristics, as describing the barbarian. Animal species can be defined in terms of behavior characteristics, as well as in terms of physiology; so can human types. Some animals are carnivorous; some, although perfectly capable of digesting meat, never eat it. These behavioral characteristics are perfectly definable and observable.

First, there is the Tribal type—the earliest human-cultural evolution. The term "savage" can be reserved for the pre-cultural level, the level when humanoids wandered about in family groupings, as do chimpanzees and gorillas today.

joined with other outcasts of his kind. Then, I like to think he took the men back there, knocked off the chief and made himself king. My kind of guy!

Our barbarian king would not have been a social reformer. He was ignorant and primitive and would have had no standards of comparison. While in the tribe, he would have been rejected by the haves and have-nots alike. Under the circumstances, he could not have felt responsible for anyone in the tribe except, possibly his immediate relatives.

No, his only real responsibility would be to those who had supported him in the takeover. All any in his group would want was as good a life as the tribe had to offer, and then some. The only reorganization would have been directed toward improving his own position.

He had been expelled by the priesthood and the now dead rulers. He would have had no awe of the priesthood, since their magic had been no bar to his takeover. But since their mumbo-jumbo served to keep the people in line, he would have kept them on. However, they would have been demoted to positions where their influence would have been primarily over the brutish majority, much as today.

Had the takeover been by the tribal soldiers, they would simply have looted the treasury, killed all those who had opposed them and imposed a military dictatorship. The general might then have attacked surrounding tribes for more loot.

But this isn't barbarism, as such. It's just opportunism by the strong over the weak. The general is still bound by the old superstitions and taboos. Some overall change might come as a result of social intercourse with the conquered tribes. Such basic cultural evolution is not a product of barbarism.

Our barbarian king wasn't interested in cultural evolution. Nor did he want revolution. He just wanted to take over the system and make it work to his advantage. In doing so, he created our modern Frankenstein, the citizen.

The citizen was but one step above the tribalist. He could go along with the traditions, rituals and taboos and sublimate his own will to that of the group. But he was superior in that he was adaptable. He could accept new ways, new ideas, and build on them.

The tribalist was not adaptable. What he had been taught at his mother's knee, by his priests and chiefs, was written in the stone of his calcified brain. He could not change.

The barbarian abolished those aspects of the system which had restricted him and kept him from fitting in. This also freed the citizen to develop and express his own positive traits and civilization was born.

So the barbarians, world-wide and throughout history, broke the restraints imposed by the weaker and closed-minded tribalists. The citizen types, freed to create and build, mainly for the benefit of their barbarian conquerers, spelled progress for all who could handle it. This also made room for many of those who could not handle progress. But more about this later.

The above is, of necessity, a broad generalization. Culture, environment, climate and various other factors also determine radical change. Basically, however, the dramatic interaction of tribalist, citizen and barbarian depends on a relatively stable, but stagnating social environment. Without the interference of barbarians, stagnation leads to decline and fall, as exemplified by the Egyptian and Chinese dynasties and the Roman Empire.

Before going on I'll give my definitions of the four types and how they interact with modern society.

First is the savage. Originally, he was the pre-tribal forager and food gatherer. As he evolved and gained skills, he developed crude weapons and became primarily a hunter of game. Life was hard for the savage and compassion as a concept was unknown to him, since its implementation requires a surplus of food and/or effort the savage lacked as a matter of circumstance.

Until cooperation in cornering game evolved, his fellows were only of value

The Tribal type evolved through the evolution of Tribal cultures; the human type and the cultural structure were, of course, co-evolving as a feedback-interacting system. The resultant human type is characterized by rejection of creativity, and by complete rejection of personal responsibility. The Tribal rituals determine all Right Living Ways; he is not responsible for anything, so long as he follows the commands of the Tribal rituals. He accepts external command—and is rewarded with security. If he obeys the Tribal rituals, the tribe will defend and protect him.

The Tribal type readily accepts slavery; the Master simply replaces the Tribal rituals. The Master now gives the commands, which the slave—better, actually, is the term "serf"—obeys faithfully, and the Master rewards the Tribal individual with security, freedom from responsibility, and the benefits accruing from sharing the higher standard of living the wiser Master can produce.

In Tribal culture, the cultural system is wiser than the individuals, and precisely that situation above described results. The tribesmen don't know why the rituals are what they are, nor do they feel they need to understand; they need only carry out the orders of traditions, and they will benefit from the greater wisdom of the ages.

The second major stage of cultural evolution came with the rise of the barbarian.

The primary change came in the fact that the barbarian accepted personal responsibility. The consequences of that are very complex, very interesting, and pure dynamite culturally. Since he takes personal responsibility —he won't take orders. He won't obey the rituals; if he does something somebody else tells him to, he does it not because he's ordered to, but because he believes, himself, that doing it is a good idea.

With the rise of personal reponsibility came, as an obvious consequence, what we know as Honor, personal

in helping to find food and mutual defense against other savage groups. His mate was only of value in helping with the drudgery and rearing his young. Only when primitive forms of agriculture and the domestication of animals evolved could the intelligent savage graduate to tribalism.

In the last editorial, John Campbell was wrong in labelling the North American Indian as barbarian. First, there were dozens of groupings and subgroupings. Many of them had agriculture and domesticated animals and had therefore advanced to tribalism. Many others, however, were only hunters and food gatherers and so were savages.

Species evolution also plays a large part in the differences between the Indians and their European invaders. During the last Ice Age, about 15,000 years ago, water levels were lower, due to the accumulation of ice covering the planet's land surface. Primitive Asiatics crossed the then dry Bering Strait and moved into the American continent.

Thus cut off from the interaction between diverse cultures in Asia and Europe, they remained at a Stone Age level of development. They knew nothing of metal working and so worked with stone, saplings, skins, bone, etc. They never used the wheel and their only pack animals were dogs and squaws.

At the coming of the White man their intelligence was lower than his. Their primitive social systems required only strength and agility on a day-to-day basis. Abstract intelligence serves little purpose for survival on such a level.

Thus, natural selection chose the physically strong and the agile to survive. Intelligence beyond that needed to outthink a bison was no more necessary in the matter of selection than was artistic ability. In all life forms, intelligence is only a tool. It simply doesn't enter into the process of natural selection unless it is critical to survival.

Many Indian groups were quite civilized, such as my ancestors, the Cherokee. Even before the coming of the Whites, they were farmers and lived in log homes. They were intelligent and most had evolved to the level of citizen. Individualists with a healthy streak of barbarism, they sided with the British during the Rebellion and fought on both sides during the Civil War, the southern faction including many slave owners.

But for John to label pre-tribal savage Indians "barbarians," contradicts his own definition. Indians at the tribalist level were enslaved, not by Whites, but by other Indians. Savages such as the Sioux, Comanches, Cheyenne and Apaches could no more be enslaved than could wolves or coyotes be broken to herd sheep. They had neither the intelligence nor the social maturity to be pressed into any useful occupation, even to their own advantage.

Incidentally, over the generations since the Whites came here, most of the savage Indians were wiped out. Their descendants have, through natural selection, evolved to tribalism.

The modern savage is as primitive and useless as the original Apache. He is, invariably, a predatory criminal. Muggers, armed robbers, theives and suchlike are savages.

Like the primitive savage, he gathers and hunts, but among the populace. Like a small child, he takes what he wants, giving nothing in return. Thus, he is a total predator, a criminal with no value to society. Once his actions have become recognized as a habit pattern, he should be sterilized and isolated or destroyed.

The savage personality is a genetic throwback to the Stone Age. He is like a child who has not grown mentally above the age of four. Whether his savagery is an actual genetic defect or a result of Minimal Brain Damage, he is seldom worth any efforts toward rehabilitation. (read "Minimal Brain Damage," Vol. 1, page 57 of THE SURVIVOR).

John Campbell's definition of the tribalist is as accurate as any I could give. But with his definition, one can hardly escape the image of a skin-clad primitive

honor. A tribesman doesn't have personal honor, because he doesn't have personal responsibility; breaking tribal taboos is evil, sinful—not dishonorable.

Every organism must seek survival of its type; if it doesn't, it is of no importance whatever in the scheme of things. For it's not long for this world, if it doesn't seek survival! "Security" is a generalized term, essentially meaning simply a sense that survival is assured. Where the Tribal type found security in the ancient, stable, wisdom of the rituals—or finds it in a Master who orders him, and takes responsibility for him—the barbarian is his own source of security.

Actually, of course, a sense of security has nothing whatever to do with actual safety. For example, there's nothing like a good, solid lethal dose of morphine to make a man's worries and fears ease away. A cat might well curl up comfortably on a nice, warm mass of radioactive matter, thermally content while the gamma radiation tore it to pieces.

The barbarian takes personal responsibility—and his security lies in the absolute, unshakable certainty that he is Right, Wise, and Capable.

This makes it exceedingly difficult to teach him a damn thing. Since he's already Right, obviously he has nothing to learn—and if he isn't right, you've just destroyed his sense of security. To accept that insecurity means, to him, that he is lost without direction, without a way to recover himself.

He has a strong sense of *personal* responsibility . . . but no great sense of responsibility for others. Fellow barbarians not only don't ask him to take care of them, they'll damn well kill him if he tries to take them over. And you *can not be responsible for something, or someone, you have no control over.*

The barbarian type evolved, and evolved civilizations. They demean the tribal type—those cowardly, subhuman slaves, who will take orders from another man! They know that

trapped in a particularly rigid caste system.

Instead, imagine our tribalist in modsern dress, driving a Chevrolet to his job on an assembly line. Although some tribalists may be intelligent, the average is dull normal.

Tribalists are owned by their respective societies. They maintain the system in the push, pull, lift categories of labor. They have as many children as biology allows and eventually swamp any system with their incompetent strain of homo sapien.

A system which has matured to where automation and computerization of its maintenance does away with the need for these dimwitted brutes should sterilize them out of the species. But just the opposite happens. They are honored as humans. They are nurtured and cared for at staggering public expense, along with their blighted young.

Without the increasingly dependent tribalist, the citizen and the barbarian could use our surplusses to create a progressively refined utopia. But not only the surplus, but the system's working capital is squandered for their upkeep. This beggars systems and keeps them on a constant war footing as each system competes for resources to maintain their increasing burden of increasingly parasitic tribalists.

The tribalist is fixed in a state of arrested adolescence. He does not have the mental equipment to work without supervision or to accept responsibility, since he is but a cog in any work situation.

Now we come to the citizen, supposedly the pride of the system, but in actuality, its most serious menace.

The citizen is generally supportive, adaptable, creative and the real mainstay of any system above the agrarian. The citizen's flaw lies in his identification with the tribalists. He is reared with the attitude that he must protect and sustain his less fortunate brothers. Their religions and traditions are part of his programming, for better or for worse.

As John Campbell says, the citizen is only one step ahead of the tribalist. Not nearly far enough ahead for him to discount them as necessary to his fulfillment as a human being. They are the foundation on which he builds his life and so the citizen is too often incapable of rejecting them.

"All men are created equal," "We are all in this together," "The brotherhood of man" and other negative populist attitudes are the guides by which he is literally enslaved by his inferiors. He believes that they are his natural responsibility.

Neither the savage, the tribalist nor the barbarian really identifies with those who are of no benefit to his progress in life. In truth, they all see society's losers as competitors, simply using up what they feel they deserve or could earn without unfair competition from those who have nothing but needs.

But to the citizen, the inferior is a sacred burden; a trust. The citizen is thus challenged to perfect a system kept imperfect by hordes of parasites. The attempt is always at the expense of the competent and simply delays the inevitable. And the inevitable is either a nuclear culling or a coast-to-coast New Delhi or Calcutta.

The chickens have finally come home to roost and our system is in serious trouble. No system so overburdened with social dependents and run by mediocrities can long prevail. Not only our system but every diverse system on our planet is failing to cope with the realities of natural law.

In our country there are nearly 250 million people. Nearly 50 million of our work force of 100 million are Federal, State or Municipal workers, paid out of taxes. Only about 60 million workers are depended upon to pay for the upkeep of our 80 million-plus, social dependents on welfare, medicare, Social Security and various pension systems and subsidies paid for by an ever decreasing number of productive workers.

Like herds of any of the lower animals, the populations of our planet have

they, and only they, are Right and Wise.

Characteristically, the barbarian *cannot* work for a living. It's psychologically impossible for him. He can, and will, fight for something he wants; that's honorable. Any form or variation of fighting is good, honorable, and manly. He can fight with swords, spears, or machine guns, or with arguments, or schemes and plots. He can get what he wants by threats, blackmail, extortion, or gift. (Which he considers a form of extortion; obviously the giver feared him and his power.) He can plot, scheme, and labor at a plan to gain his ends—but he cannot work for it.

He can risk life, health, or crippling, labor twenty hours a day for weeks digging a tunnel to penetrate to someone else's treasurehouse; that is honorable, manly, tolerable because it's a form of fighting. But he can't work in a mine to dig out gold from Nature's treasurehouse; that's unmanly, demeaning *work*. Work is what slaves and women do. An honorable man can hunt, fight, and plot—but not work for economic productive ends. Only slaves and women do that.

The European nobility, until relatively recently, held precisely that attitude; it was demeaning and dishonorable for a nobleman to engage in trade—i.e., to do anything economically productive.

The American Indians, when white men first arrived in the United States area, were true barbarians. They did not, *and could not*, work for a living. The colonists confused them acutely, because they worked for a living . . . and a few preliminary skirmishes established very definitely that the colonists were not cowardly weaklings, not the demeaned slave type.

The colonists, however, found that the North American Indians could not be enslaved; the Spanish tried it, and were murdered for their pains. In the United States central and eastern areas that is; in the Mexican-to-Chilean areas, the Indians had advanced

simply outbred the carrying capacities of our planet's social, economic and ecological systems.

There are nearly five billion people on earth. Not only are there too many people, but most of them are not up to meeting the challenge of enlarging the productive capacities of our systems.

Intelligence and overall competence is declining disastrously. Even our mediocre politicians are protesting our frivolous, silly, and imbecilic students and our schools, which do little more than babysit those unable to learn useful skills.

Something has to give, and as with every past overburdened and unbalanced system; the bell is tolling.

Today, over 40 wars further ravage the Third World. Destitute refugees from war and economic prostration are beginning to swamp the economies of every industrial nation.

Whole towns are evacuated because of chemical pollution. Acid rain, a result of manufacturing for so many people here and for export, costs over two billion dollars a year in the U.S. alone in erosion of our buildings and monuments. It also destroys all life in many of our lakes and streams and even denudes our forests and threatens our croplands. Added to all this, the weather is increasingly turning on us, destroying homes and businesses as well as croplands.

No one who can read this has failed to see the degenerative processes shown in living color on every news program.

Most positons of authority on this planet are held by citizen types. Seeking only stopgap solutions and then only for their own dependents, world citizenry has become an actual threat to the species. Politicians, doctors, lawyers, bureaucrats, society's fair haired boys, are actually the most dangerous enemies of the species today.

Take for example, the most respected citizens of our society, the doctor and the lawyer. Medicine and law require the highest intelligence, on the average.

The kindly doctor occupies himself largely with saving those whom Nature dictates should be taken out of the gene pool. The doctor, however, fights Nature by improving the chances of the genetically blighted long enough for them to pass their defective genes to the next generation.

Progressively, generation by generation, doctors have lowered the quality of the species. Moreover, their work among the underachievers has simply served to swamp society with a perpetually expanding population of dependents.

Medical missionaries have wiped out epidemics in the poorer nations which had, up until then, served as culling agents. In taking away these natural restrictions to unwanted population growth, doctors have caused far more suffering than had they let well enough alone.

Whereas there was some suffering, now it is universal as those saved from Nature's culling agents have proliferated to an alarming degree. Thanks to our citizen doctor, malaria no longer takes one out of ten. Instead, about eight out of ten are in danger of outright starvation.

And so they film mobs of pot-bellied, fly-blown African children, just waiting to die. Meanwhile, their tin-pot dictators organize the starving adults to war against the surplus populations of their neighbors.

I don't mean to give the impression that any preventable suffering is acceptable. Doctors must relieve suffering and promote the physical and mental wellbeing of everyone. But the price for the care of the underachievers and genetically blighted should be sterilization, for their benefit and that of the species.

The citizen lawyer must guarantee a hearing and justice for everyone ac-

to the third stage of cultural evolution —the citizen stage—and could be enslaved. Because a citizen can work for a living, and be creative, and be responsible for himself.

So the primary characteristics of the barbarian are that he is intransigently sure of his unarguable rightness, and that he cannot work for a living, but can only fight—in one variant form or another—for what he wants.

The third level of cultural evolution so far is the citizen; he differs from the barbarian thanks, largely, to the barbarian's millennia of tutelage in "How To Learn a New Way Of Life . . . or Die!" The Citizen is marked by a flexibility of thought, of value systems, and of learning-processes that the barbarian doesn't have. The citizen can work for a living—he can be economically productive. (The barbarian can be an artist or an armorer, incidentally, but not, for example, a farmer, a machinist, or a chemist. The artist is expressing his own opinion; the armorer is making the sword he plans to use.)

The citizen is able to consider and evaluate someone else's ideas, as well as his own. He not only has a sense of responsibility for himself, but feels responsible also for others. And the citizen is the first level of humanoid that has been able to *live with a sense of insecurity*. He can think, and *not be sure his thinking is necessarily right.* This is what makes it possible for even an adult citizen to learn an entirely new way of life, even one he does not want.

Now comes the truly important problem—the true Menace of the Barbarian today.

The Barbarian is not adaptable, has no sense of responsibility for anyone else, and wants to fight, not work, for a living.

A barbarian is *not* necessarily a stupid lout by any means. That behavior pattern can apply to any individual, without distinction as to race, creed, color, or I.Q. The barbarian

cused of a crime. But all too many lawyers are merely apologists for criminality. The criminal is the hero, noble but underprivileged, his every rotten act a protest against a system which took away his birthright So conscious of his rights are lawyers that lest any injustice touch him, the suffering and/or death of his victims must be ignored because of meaningless technicalities. As often as possible, he is released to repeat his crimes and worse, to reproduce his criminal kind. The lawyer not only protects many savages from justice, but further pollutes the species with an atavistic breed an outraged society would do better to exterminate.

So the doctor and the lawyer, the most admired of our professional class, are actually trained to save the worst at the expense of the best. As a group, they are a tangible threat to the species itself.

Of all the citizens who are well-meaning but destructive to the species, politicians are the worst. These vermin are usually well educated, however stupid, and fanatically dedicated to getting re-elected.

Since their terms are from two to four years, they don't need to plan far ahead. No matter what waste and misery their re-election boondoggles cause, they seem to honestly believe they can iron out any difficulties after their re-election. If they fail, they simply say the measures were necessary because of the mess created by their political opponents.

As an example, note the massive shoring up of our fractured economy by our super citizen President Reagan. The 1983 bill for Social Security, medicare and various other useless domestic programs cost the taxpayer $479.8 billions. Estimated costs for insuring the loser vote in 1984 is $493.9 billions. What with the mounting deficit and the ridiculously expensive social programs, if the economy makes it through the next election, inflation will wipe us out.

The reasons for these costs are the citizen's identification with those he feels obligated to preserve; the unfit and the unnecessary. The political citizens' present pet project, "The right to life," shows how even compassion can be perverted.

Only Nature determines the right to life. All the citizens' efforts to prolong useless life or to bring more of it into the world simply leads to perpetual suffering and waste. But prolong it they will, and usually in the name of Christianity.

I'd have no complaint against Christianity if its adherants stuck to its original format. It was simply a prepartion for an afterlife with rules of conduct concerning people already here. But when any religion is used to add genetic and social defectives to our culture and species, it bears re-examination.

There are literally millions of unwanted children in the U.S. who are physically and sexually abused, poorly clothed and inadequatedly fed. If the Christian political citizen were truly compassionate, he would address his humanitarian efforts to this sector.

The pious hypocrite, Senator Jesse Helmes, shows no compassion for live children. His efforts go toward adding more hungry mouths and abused bodies to our welfare roles. He believes that the abortion of unwanted and therfore automatically rejected children born to usually defective parents, is murder.

Although Helmes' Bible doesn't mention the willful termination of pregnancy, this redneck Jesus presumes to speak for his god. He does so out of ignorance of the subject.

Exodus 21:22-23 says:

22 If men strive, and hurt a woman with child, so that her fruit depart from her, and yet no mischief follow: he shall be surely punished, according as the woman's husband will lay upon him; and he shall pay as the judges determine

23 And if any mischief follow, then thou shalt give life for life, . .

In short, if a man causes a woman to miscarry and lose her child, he is simply fined. If "mischief" follows, which could only mean the death of the woman, he dies.

So the writer of Exodus obviously didn't consider the unborn fetus to be a

can be enormously intelligent . . . and still be a barbarian as specifically defined by the behavior pattern given above.

Perhaps the all-time high example of a true, high-intelligence barbarian was Socrates. That may sound outrageous—but run it over for data! Socrates *would not* work for a living; his wife and children got along as best they could, for he had very small sense of responsibility toward others. (A man can *talk* a fine game, and not be able to play it at all. I learned a lot about the fundamental nature of ethics, morality, and honesty from a man who's an amoral psychopath; he could consider these matters with a degree of objective detachment I hope never to achieve.) Socrates could fight endlessly—argumentatively, or as a warrior against Sparta. But he did not engage in any economically productive activity, except bumming from his friends. He was intransigently and unshakably certain he was right; he "had a demon who told him" when he was right.

Socrates showed every characteristic of the true barbarian personality pattern—and the fact that he was enormously intelligent has nothing to do with that fact.

On the other hand, Aesop, who was a slave, showed the pattern of the true citizen. He was highly intelligent also —but that is a completely independent variable; citizens can be low-grade morons, or ultra-high geniuses. Aesop, however, could adopt many viewpoints, many value-systems, as he did in his fables. And he could accept slavery, and still remain mentally sound and accomplish things.

The barbarian is the greatest menace to civilization today because he is inside, not outside, the culture. The barbarian can be intelligent, can plot and manipulate with immense skill . . . and utter self-centered trickiness. He has a strong sense of personal honor—which includes the honorableness of being too tricky for your opponents to trap. The barbarian's sense of honor is powerfully dominant over his ac-

living being with a soul, regardless of its potential. Otherwise, the man causing the miscarriage would have forfeited his life. If the Bible was inspired by the Creator, then the Creator doesn't consider the unborn an entity but only a potential shell or vehicle for an entity.

My editorial on page 57, Vo. 1, of THE SURVIVOR showing diagrams from Psychology Today proves a child is not human before its brain cells are properly linked up. Before then, humanity, the level of consciousness and awareness which differentiates us from the lower animals is impossible.

So neither the Bible nor science supports the idea that the unborn are "human," despite their potential. So to force an ignorant, impoverished and usually defective woman to complete an unwanted pregancy is not only cruel and inhumane, but an injury to the species. (See ANTI ABORTIONISTS, RIGHT TO LIFERS OR GUARANTORS OF DEATH, page 455, Vol 3 of THE SURVIVOR).

Jesse Helmes is too ignorant of the Bible to be a spokesman of its tenets. His only real link to Christianity is in the Bible belt where he solicits the votes of the uneducated. But like most citizen politicians, this short-sighted monster considers himself a true humanitarian while causing untold harm both to children who ought not to be born, and to the species itself.

Another citizen actively threatening the species is the real Adolph Eichman among American politicans, President Ronald Reagan. (In case you are unfamiliar with Eichman, he was a German concentration camp commandant accused of imprisoning many innocent people under particularly brutal conditions).

During the '60s I had occasion to talk several times with George Lincoln Rockwell, leader of the American Nazi Party. He was quite intelligent and a true barbarian, albeit of a negative strain. However, he was no more a National Socialist than my dachshunds and was so vulgar he could never have attracted decent barbarians who would actually implement whatever system he might have settled on had he not gotten shot.

Anyway, once we were talking about the treatment of felons preying on society. We agreed they should be destroyed. Then he cited special cases such as those convicted of crimes against children. I was almost shocked by his plans for them. He would have had their arms, legs, eyes, eardrums, tongues and sex organs surgically removed. Then, fed intravenously, with waste tubes attached, he would have simply put them on shelves and let them meditate on their sins for however many years they had left.

Ronald Reagan is worse in actuality than Rockwell was in his fantasies. Rockwell's victims would have been deserving of extreme punishment, but Reagan's are totally innocent children.

About a year ago a child was born with part of its internal organs outside its body. It was hopelessly retarded and had no potential for growth and development. For the duration of its futile existance it would have been a vegetable with no brain in which to store knowledge or with which to communicate.

Imagine you are totally wiped out with alcohol or drugs. You're still in there but the impressions you get through your brain are totally distorted and any communication you might want to make is unintelligible. You'll be all right tomorrow, but what if that was to be your permanent condition? Who would have the right to condemn you to such imprisonment for the rest of your life?

Or say everyone was allowed only one automobile for life? What if you get a lemon? There you are, barely able to chug out of your driveway, a constant traffic hazard with no brakes, horn, barely functioning engine. You couldn't go on the freeway and, while everyone else was out there tearing around, you would spend the rest of your days in some garage or body shop. Wouldn't you rather junk the car and take any other alternative?

tions—he will kill himself for honor. But it doesn't happen to include honesty as part of honor.

Honor, to him, is achieving a high standard of living by fighting for it; dishonor is working for a living. (This may be a very subtle point to an outsider; Socrates would have been able to teach at a university without considering that he was demeaning himself by working—but wouldn't have been able to accept a job with a corporation as a mathematician.) A shyster lawyer can be a barbarian; typically, to him, the law is a system of strings with which to weave traps for others.

The menace arises from this factor; he has a sense of honor, but no sense of ethics, and no adaptability. The citizen is the type that builds civilization; the type that can work productively, can adapt his views so that he can integrate and work with others who have different viewpoints, different ways of life, different value systems.

The citizen *can adapt.*

The barbarian *can't adapt.*

When citizen and barbarian come into conflict within a culture—it is inevitable that *the citizen will tend to adapt to the barbarian because he, alone of the two, can adapt.*

The citizen will learn barbarian manners from the barbarian; the barbarian will learn nothing from the citizen.

But the barbarian will learn how to defeat his enemies—the citizens. He'll learn how they can be tricked, cozened, argued into corners, and conned into nonsense. He, who doesn't have any sense of responsibility for others, will keep assuring the citizen that *he* must feel responsible for others.

The barbarian won't work—and will insist to the citizen that citizens should feel responsible for the unemployed barbarian, and should support him in the style he'd like to become accustomed to.

Hitler was a barbarian; the Anglo-French leaders were citizens, and were conned into giving up Czecho-

Back to the blighted baby; it had been the practice that such babies were denied nourishment so that they would die. Humanity dictates that such babies should be given a shot of something rather than add to their misery through starvation and neglect.

But that's not the real point. The real point is that some Goody-Two-Shoes degenerate in the hospital was able to attract Reagan's attention to the fact that the baby was being written off. So our monster on the white horse decreed that all such babies should be kept alive no matter what it took, even if such prolongation of useless misery beggared the parents or cost the taxpayers literally millions of dollars.

You must have seen films of the Baby Jane Doe a while back. Her non-functioning brain was three times normal size, she had no eyes and her little limbs would never let her move about or grasp toys she couldn't have seen anyway.

Surgery might have kept her breathing for years and her parents were against it. But they had no say in the matter. Reagan and his ilk would not only put the burden of permanent misery on the baby, but force the parents to care for it to the exclusion of healthy children. Luckily, it died.

Regardless of what you might think of Rockwell, his victims would have been criminals. Reagan's victims are innocent of any wrongdoing. So who is the more callous, Rockwell or Reagan?

Nature, or God, if you will, has set laws by which physical organisms function for the benefit of the individual and the species. If the organism is non-functional, natural law decrees it must be eliminated. But Reagan has outlawed Nature, or God.

It is necessary and normal to show love and compassion for the helpless. But the policy of saving genetic dregs imposes an unfair burden on the families and the taxpayers. Worse, it often preserves genetic defectives long enough for them to further pollute the gene pool, the most valuable asset of the species.

If you examine most of the problems threatening today's systems, you'll find Goody-Two-Shoes citizens behind them. The citizen is invariably trapped into a belief system which gives him a god-complex concerning his lesser endowed fellows, the tribalists.

Of course, the citizen is also the greatest exploiter of the tribalists. Through his religions, politics and economic systems he has enslaved nations while enforcing the tribalist's concept of the greatest good for the greatest number. That concept works only through the individual's freedom to develop and express all his positive traits. But when it enslaves the individual of quality to the physical needs of those born to no purpose, it becomes a tyrannical waste of both valuable people and unrenewable resources.

Enter the barbarian:

John Campbell gave a very good description of barbarians. but he tended to lump the superior barbarian in with the inferior savage. Thus, although he credited the barbarian with the qualities of personal responsibility and honor, he still labelled those of savage behavior and characteristics as barbarians.

You can't have it both ways. The savage is the most primitive member of any society. His brain is either unformed or warped so he is unfit for sustained effort on his own behalf. Therefore, he has no choice but to reach out and take.

The savage is inferior to the task of contributing to the needs of the tribe so he is worthless to them. Of course he has no sense of personal responsibility since he is still a child in a state of arrested development.

In wars and social upheavals it often happens that, since a savage knows no limits, he is appointed to jobs only a brute will perform. So John labelled such savages as Hitler, a barbarian, along with any other losers who make

slovakia, in 1938.

However . . . Churchill was a citizen, too—and when a citizen refuses to be conned, recognizes the barbarian as inherently incapable of productive effort, co-operation, or adaptation, the citizen's greater range of abilities can fairly surely destroy him.

The barbarian wants to fight for a living; he likes life only in those terms.

The citizen is a past-master barbarian; he's gone through that stage. He *can* fight—if he realizes that that is the necessary answer to the intransigent, self-centered, honorable-but-dishonest barbarian.

The great menace of the barbarian is that the citizen *can* adapt to the barbarian—and civilization, which depends on citizens, disintegrates shortly afterwards.

The Tribal type, a civilization can use; the tribal pattern individual will work, and work honestly and faithfully. He is not creative; he seeks the security of routine and tradition. But remember, these personality pattern types have *no correlation whatever with intelligence, race, color, creed, or physical shape*, because they are *individual* characteristics. (Race does enter—but solely on a statistical basis. Cultural evolution, remember, acts as a selective breeding mechanism, and produces a strong selection of statistics in the resultant group. Such a selected group will *not* show a Gaussian distribution, naturally!)

One can find a pure tribal-pattern individual with an I.Q. of 175, a professor at a University, where he is patiently, faithfully, and competently carrying on the highly intellectual traditions of his scholarly field. He's still a tribal type, however intellectual a tribesman he may be! He will have the virtues of loyalty, honesty, and patience—but will be entirely non-creative, and will oppose all suggestions of change in the traditions and rituals of the University or the field he is engaged in.

Or the highly intelligent tribesman type may be a chemist, doing quality-control analyses, checking to see that a name for themselves after a career of brutish exploitation.

A barbarian is simply an individualist. He thinks his own thoughts and implements his own programs. Being superior to the tribalist, he won't play their communal games so they reject him. He won't work with the citizens' committees by which they seek to enslave everyone to the common good, so he's considered unadaptable. But why should he adapt himself to systems set up for others, wherein he is just an unimportant cog working far below his natural capacities?

The barbarian, having little or no interest in the standards imposed by mediocrities goes his own way. And when a system serving only his inferiors is closing in on him, threatening his own liberty on behalf of those to whom liberty is only a frightening separation from whatever despotism they are used to, the barbarian rebels.

Throughout history, most of those who have broken new ground in science, industry, invention, the arts, exploration, warfare and social progress, have been barbarians. They were simply men who followed their own vision.

The citizen simply wants to fit into and serve or exploit whatever system he has. To him, the barbarian is indeed an uncooperative lout and even a social traitor. He realizes, often unconsciously, that the superior person, individualist, groundbreaker and natural warrior, is a threat to his own ambitions.

The citizen cries crocodile tears at the suffering of our millions of unwanted children. But he encourages more such births since some might survive to vote for him. Or maybe he has stock in a diaper factory. The barbarian doesn't need to exploit suffering inferiors to make his living.

At this time, while the central authority is still intact, the barbarian can only selfishly stock up for himself and his loved ones. But in the event of a nuclear war or total socio-economic collapse, the surviving barbarians will take over as a matter of course.

This takeover will be much like that implied in Ayn Rand's "Atlas Shrugged." Most of her lead characters are true barbarians. Like most of our founding fathers, her characters refuse to contribute to an exploitive system.

Whereas our barbaric founding fathers actively fought to overthrow the British exploiters of themselves and their fellow colonists, Ayn Rand's characters simply withdrew. Withdrawal is our only option at this point.

Withdrawal is simply a strategic retreat in the face of the citizens' overwhelming strength, backed up by their masses of tribalistic marching morons. We need neither the citizens locked into their monstrous establishment nor their tribalistic goons made worthless by a system needing fewer hands and dull brains.

In order to inaugurate the next step in the evolution of human civilization, which would be the systematic culling of social dependents and predators, barbarians must withdraw and consolidate their strengths. This will require relocating to rural areas and becoming increasingly independent of our doomed system.

As a barbarian, you might have some idea of taking over your territory after the central authority has collapsed. This is fine if you have a broad frame of reference and can supply your followers with the technology they'll need to rebuild.

Just being armed to the teeth will only make you a target. After all, weapons are so common that if that's all you have, you will just be another armed hooligan. You will have to be purposeful and useful to those you need in order to implement your own ideas.

The best system you can implement directly following the collapse is one which tests the ability of the competent to survive without interference. Thus, you would have to give those around you the choice of occupations which would make them independent of everyone, including you.

No better foundation for a system for developing the talents of barbarians,

the company product does in fact meet ASTM standards test #237-B-2, or the relevant MIL specs. Here, his inherent lack of creativity is one of the highly desirable features of his nature; when a man is supposed to check something against an established standard test, originality, creativity, and ingenuity are the last things wanted! The new, shorter, and easier test he invents may be wonderful—but it is *not* ASTM standards test #237-B-2, which is what the contract calls for!

A citizen could do the quality control job, because he can appreciate the necessity of the noncreative viewpoint, and adapt to it. He'll be uncomfortable, though, because in such work he'd be using less than his full potential.

The one who absolutely could not carry out the job would be the barbarian personality; being rigidly limited by someone else's orders is dishonor, it's intolerable . . . he'll break out because he *can't* work that way.

The menace of the barbarian lies in his intransigence, coupled with high intelligence, argumentative persuasiveness, and pleasure in fighting. The citizen, because he is adaptable, will gradually adapt to the barbarian's intransigent demands, because the citizen cannot continually fight off the barbarian and accomplish the productive things the citizen yearns to achieve.

The citizen fights only to accomplish; the barbarian fights to enjoy the fight and to win. In argument, the citizen seeks to find the truth—the barbarian seeks only to win. The barbarian has an intense sense of honor—and neither honesty nor truthfulness, morality nor ethics. But he will call upon the citizen to be moral, ethical, honest and truthful continually.

The barbarian well knows that the best weapon to use is one that can hurt your opponent—but which cannot touch you.

Until the citizen realizes that self-defense is not only an ethical right, *but also an ethical duty*, he will yield to the barbarian simply because he *can* adapt.

The simplest sign of barbarism is the characteristic that they will *demand*, on moral-ethical grounds, that they be *given* something they claim as rights, but will not accept that it must be *earned*, must be *worked* for. They will threaten to fight for it, and will fight for what they want—but will not work productively to earn it.

The essence of the barbarian approach was boiled down very neatly in Hitler's cry of "Guns before butter!"

Guns are to fight with; butter is fuel for hard work. ■

or individualists, if you prefer, is the 19th and early 20th Century science and technology known as low technology.

Low technology embraces farming, light industry, and cottage industry. Although producing plenty for the actual producers who can trade with other enterprising individualists, little real surplus would be generated.

(The overall layout for such a system is found in the five volumes of THE SURVIVOR. There are hundreds of trades and light industries easily implemented by the intelligent layman. You can use these ideas, mostly by barbarians of a few generations ago, to start your own dynasty. You can also put others to work duplicating the old processes).

The great surplusses generated by our wasteful and ecologically destructive system would no longer be there to be used by citizens to simply preserve the bodies of those born to no purpose. Initially, the weak and dependent would die off and only the strong and purposeful would prosper.

By the time society redeveloped and grew to a high level of agricultural and industrial productivity, future surplusses could go toward the betterment of the species. The savages will have died or been killed off. The tribalists who survive can be sterilized, as their issue is not only unimportant, but a drag on progress.

Citizen type children could be encouraged to excell at what they do and constantly expand their frames of reference. They should be taught their only social responsibility is to produce as good a product as they are capable of. Once they learn to adapt to the standards of excellence demanded by barbarians they will lose their identification with tribalists and savages.

Then there will be plenty for all who can earn it. There will also be plenty for those too lacking in ability to support themselves. But since social dependents will be sterilized, society's burden will be negligible and the species will gradually strengthen.

Within a generation there will be few savages and not many social dependents. With the gradual reorientation of the citizen types there should not be another citizen menace for several generations, if ever. Then, there will be such scientific and social progress that the cycles of growth and decay of civilizations could be replaced by an ongoing system of refinement of both man and his life support systems. Space science and its spinoffs could give the species lasting socio-economic benefits instead of the short-term economic benefits generated by wars.

When barbarism, or individualism, becomes the norm, your descendents will crew space ships and build cities out there. Only those who realize that life quality is all important and unproductive existence is a threat to the species will be considered fit to make decisions in the future.

American Shells for Guns

Scientific American—June 15, 1861

We have received a pamphlet written by W. W. Hubbell, Esq , of Philadelphia, in which he claims to be the inventor of the destructive explosive shell used in the American navy. He asserts that in 1840, he made a verbal agreement with Col. Bomford, chief ordnance officer of the United States, to introduce and manufacture his shell for the service, and that 100,000 have since been made. The agreement was to the effect that he should receive one dollar compensation for every shell made, but as yet he has never obtained any remuneration. Paixhan, the French artillery genius, who first introduced shell into naval warfare, preferred those of concentric form, and these are the kind now employed in all navies but our own. Hubbell's is an eccentric shell, claimed to be superior to those used in other navies, and it proved very destructive in blowing up the granite Bogue Forts near Canton, in China, a few years since, by our naval forces. Mr. Hubbell commenced his experiments with these shells in 1840, and on the 22nd Sept., 1842, he fired three 32-pound shells from the battery at Sandy Hook, by order of the Navy Department, in the presence of Commodore Wadsworth

Formerly bomb-shells were all thrown by mortars —a short wide mouthed gun set at an angle of 45° Those shells were thrown at a great elevation, and their range was obtained by different charges of powder in a back chamber of the mortar. Paixhan practically introduced the system of discharging shells horizontally from cannon, similar to solid shot.

Firearms And Rifle Breech Loaders

New York, Saturday, January 26, 1860

The subject of firearms has engaged much public discussion during the past few years, and it is now attracting more attention than ever Nearly all Europe appears to be an armed camp. England has two hundred thousand volunteer riflemen in constant drill· and at home, the notes of warlike preparations resound throughout the land For two centuries, the free yeomen of America and the sturdy Switzers of the Alps were alone distinguished for skill with the deadly rifle , but it has now become the weapon of all armies, and there is no nation which can claim preeminence in the skillful use of it. The first correct writer on the [illegible] was Robins, an English soldier who wrote upon the subject about [illegible] years ago He explained the [illegible] and declared that, [illegible] it was adopted, wonderful effects would follow The theory of the [illegible] and the advantages of this weapon are only appreciated But there are great and essential [illegible] and of course, all can [illegible] Breech loading and muzzle loading rifles, the [illegible] the light English rifle, with its smooth tapering barrel the heavy Swiss rifle, with its thick breech and muzzle, and the long heavy American rifle with [illegible] barrel There are also [illegible] of rifle grooves, and [illegible] being unimportant On the sporting rifle has been written that is more [illegible] Chapman author of the American Rifle [illegible] Colonel Jacob of the East India [illegible] writers on this [illegible] has also

The Independent Citizens Army

By Kurt Saxon

(This editorial is one I wrote for the front of a catalogue of my books ten years ago. It is just as true today as then and my attitudes concerning political charlatans and paranoids have not changed. I stated then as now that joining "Patriotic" groups and showing hatred for our government is counterproductive. Our politicians and Dept. of Justice are all too often incompetent but I have never known them to interfere in the legal activities of any individual or group).

Dear Friend:

You've probably been asked to join this group or that movement lest our country fall to the enemy. As times get worse you might be tempted. I was and I joined everything I could. In time, nearly everyone was named as the enemy. If we could only get rid of this bunch or that, we would be secure. In the meantime, we dedicated world-savers were nickled and dimed to a state of poverty by the heads of the outfit. But it was for *the cause*, you see.

Of course, *the cause* seemed to center in the hind pocket of whoever claimed to have the answers. Also, *the cause* was about 80% propaganda, 15% wishful thinking and maybe 5% action. But no accomplishment. In the meantime, nothing changed except for the worst.

I finally got fed up with supporting a bunch of paranoid bums and started looking for my own answers. I suggest everyone else start thinking for himself and cut loose from any similar groups taking away his time and efforts from preparing for his own survival and that of his family.

The political parasites would leave you ruined when the time of chaos comes. In that time, the enemies they name now will be in just as bad shape as everyone else.

So take their "enemies" with a grain a salt. You can't hurt "the enemy" and I'll tell you why.

If the enemy was any identifiable group it would be against the law to attack them. Threats or attempts in that direction bring in police, and on occasion, the FBI and ATF. Anyone who is really serious can't get far enough in his activities to do any damage to "the enemy" as a group. He will only be jailed, or most likely, just be put under surveillance as a dangerous political activist. At that point, he doesn't do anything because he doesn't dare.

After wasting years and money and effort against every group I imagined was the enemy I came to see them all as just mobs of people heading for the same chaos as the rest of us. Their activists who stood out were just loud-mouthed, frustrated malcontents like I used to be when I was brawling with them.

So I don't believe any group is "the enemy". I believe the problem is national and even world-wide degeneration. There are just too many people breeding dumber and more unfit offspring each generation. The more of such people born, the more unrenewable resources are used up and the more our planet is polluted so that fewer people can live on it.

So where does all this leave you? As things get worse you will be the target of moronic criminals, starving mobs and maybe even foreign invaders. Your neighborhood might be an island of relative plenty in a sea of chaos and famine.

When that time comes, the more people like you spread around the country, the safer our country will be.

In the meantime, the Law can prevent you from being effective against any named enemy. Soon, though, the Law will be helpless. They are hardly effective even now against criminals and the jobless, rootless wanderers whom you can neither fight not imitate at this stage of the game.

When these elements wear down the Law it will be *your* turn to howl. Then you can destroy those who threaten you. But not before.

been ately published in the London *Mechanics' Magazine*, by W Bridges Adams, a practical engineer and writer on mechanical subjects Some of his views are full of good sense, while others exhibit a want of thorough practical acquaintance with rifles.

European writers on firearms seem to be unacquainted with what has been done in America by our gunsmiths. The conical or elongated Minié projectile, which has become the favorite in Europe, is the old picket bullet used by American riflemen, with the addition of a chamber and plug in its stern. Adams' says: "All forcible expansion of leaden bullets within the barrel by the explosive action of the gas is a mistake—it wastes powder and alters the form of the shot into irregularities, tending to irregular flight." He thus declares that the expanding bullet is not reliable for accurate shooting We have seen several experiments made with the expanding and the old solid picket bullet loaded at the muzzle, in which the latter always proved the most reliable It must be acknowledged, however, that the expanding ball has its advantages in warfare. With it, a soldier can load his rifle as easily and as fast as a musket; and if it is not quite so reliable, it is better for rapid firing than the solid ball. But it has no other advantage than this; and above all things, certainty of striking should be the first object in firearms; quick shooting if we can, but accuracy by all means.

American first class rifles are the best in the world. The foreign Enfields, Whitworths and Lancasters are far inferior to them. The reason of this is obvious. Rifle shooting has been a favorite American amusement for a hundred years, and it has been a matter of national pride, as well as of security, to excel as marksmen. The greatest care and the highest mechanical skill have been called into requisition on the part of our gunsmiths to make perfect rifles, and they have been successful beyond all that Europe can boast. A Wesson, a James' or a Fish rifle is always a "dead shot" in the hands of American marksmen: the instrument, when in proper order, never fails.

At present, we believe that the muzzle-loading rifle, with the tight fitting conical bullet, is the most reliable, and the principles involved in its construction are few and simple. The barrel should be of the best close-grained cast steel, and its weight sufficient to give it stability. It also appears to be advantageous to have the barrel of an octagon form, and of the same diameter from end to end. When the charge expands in the barrel of a rifle, a series of undulations are produced, which operate to give irregularity to the flight of the projectile. The angles of the octagon rifle barrel tends to arrest these undulations. This was discovered long ago by our backwoods' marksmen; but this principle does not seem to be appreciated by most army officers, who have provided round barrels for their rifles. The size of the bore in rifles is a matter of convenience and choice. The larger the bore the greater proportionately should be the weight of the barrel, to give it stability. The interior of the rifle should be as smooth and polished as the inside of a steam cylinder, to avoid friction in the passage of the bullet. There is quite a difference of opinion as to the best length for rifle barrels. This is an important feature, because the pitch of the rifling is always in accordance with the length of barrel. The heavy, long western rifle, with its moderate spiral, is considered by many persons to be the most reliable; while others assert that a short barrel, with a slow starting spiral and an increasing twist towards the muzzle, is as reliable, and is preferable to the long barrel The number of grooves in a rifle is not of much importance—three are better than a dozen—provided the bullet be made to spin properly, they should be as shallow as possible, however, to prevent windage. The German rifles have short barrels and a rapid twist. Colonel Jacob states that he found, by many experiments, that a barrel two feet long, with the grooves full and of a breadth equal to the *lands*, and giving a revolution once in three feet, was equal to barrels two and a half and three feet long The muzzle of a rifle should be perfectly true; for if

So my advice is to gather a small group of like-minded friends and prepare. Collect knowledge, guns, raw materials and food.

Train together in relatively safe and legal ways. Join the National Rifle Association and local gun clubs. Attend gun shows and rifle ranges. Don't be too secretive about your group activities. Be open with the police. They won't approve, on principal, but so what? It's your country and since you don't intend to act until the police are helpless, it's no business of theirs.

Recruit a cop for your group if you can. He may keep you from making mistakes through ignorance of the law. And when he finally throws away his badge in disgust he will be one of your best.

Being fairly open in your aims will eliminate the paranoid fanatics, who are good for nothing anyway. Openness also keeps you pretty free from infiltraters. And you will be surprised at the things you can get away with which you now might think would land you in jail.

A perfect example of the kind of outfits I have been suckered by is the National Association to Keep and Bear Arms, (NAKBA). I single them out not only because they are a perfect example but because they asked for it. This way, they serve me even better as an example than as advertisers.

The following letter was sent to me by a person who claims to want a strong America. National Association to Keep and Bear Arms? Publishers of the Armed Citizen News? Yet, their head boy rejected an ad for the Poor Man's James Bond; the single book which would make his every member the ultimate armed civilian. And his reason? He didn't like my dedication in the sample copy I sent him.

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July 6, 1974

Mr. Kurt Saxon
Atlan Formularies
P.O. Box 438
Eureka, CA 95501

Dear Mr. Saxon:

Your request to place an ad in the Armed Citizens News was considered by the Board of Directors. After we examined the book, "Poor Man's James Bond", we did not feel it was acceptable, because it gives plaudits on one of the front pages to Sirhan Sirhan and Lee Oswald among others. Both of these men are self-acknowledged MARXISTS. We do not wish to be connected with them in any way.

Thank you for the request.

Yours for God, Family, and Country,

Charles L. Adams

Charles L. Adams
P.O. Box 99
Redding, CA 96001

CLA:[redacted]

"Affectionately dedicated to:

there is the least defect at the issue where the bullet leaves the barrel, shooting becomes mere chance work. Clark's patent loading muzzle—an American invention—has conferred a superiority for accuracy on all rifles furnished with it.

It is admitted that rapid loading is desirable, and that this is obtained with expanding bullets; but these are not reliable. But, then, are not accuracy and rapidity of firing combined in breech-loading rifles? The late Secretary of War, in his report, said: "I think it may be fairly asserted now that the highest efficiency of a body of men with firearms can only be secured by putting into their hands the best breech-loading firearms." This conclusion, it seems, was arrived at after a great number of experiments by army officers. There can be no question as to the ease and rapidity of loading breech-loading rifles, but they are not considered so accurate in firing as a good muzzle-loader. We have seen several trials of skill with the two kinds, in which the breech-loader usually failed; and yet we do not see why this should be considered a settled question. There is nothing in theory, and there should be no positive difficulty in practice, to prevent a breech-loading rifle from being made to carry as accurately as any other. We shall recur to this subject in a future article.

Projectiles For Rifled Cannons

Scientific American—Dec. 21, 1861

Means. Errors.—The important results, in a military point of view, which have been obtained within the last few years, by rifling the bore of cannon and adapting thereto an oblong shot or shell of a cylindrical-conoidal form, whereby the explosive force of the charge is made to give the projectile a very rapid rotary motion around its axis, counteracting the inequalities in the density thereof, producing a greater precision and a more extended range, are facts familiar to every one conversant with this subject. It is not a little remarkable, however, that after the improvement has been for a number of years successfully applied to small arms, that so much time should be allowed to elapse before its introduction into the construction of ordnance. In fact, most practical men, in the earlier progress of the improvement, are said to have looked upon the application as practically impossible (*vide* Renwick's "Elements of Mechanics," article "Projectiles"). This we take as another demonstration of the difficulties to be overcome in the progress of improvement, early prejudices must be surmounted, and it is hard to divorce those who may be wedded to their idols.

In referring to projectiles fired from rifled guns, we wish particularly to call the attention to the condition and results which pertain to the projectile from said improvement, namely, that shot or shell thus projected, will have its axis firmly held and preserved parallel to the trajectory or path in which it moves during its flight. This condition, it will be seen, forms the basis or foundation favorable to the application of our proposed improvements. If we assume, for instance, the velocity of the projectile to be 1 500 per second, and the rifled twist of the bore of the gun from which it is projected, to make one turn in ten feet, the said projectile would make about 150 revolutions per second on its axis during its flight. This rapid gyratory motion most evidently gives the mass of the projectile a *vis viva* that would require a considerable disturbing force to resist and overcome it.

Lee Harvey Oswald
James Earl Ray
Sirhan Bishara Sirhan
Senator Ted Kennedy"

You may not have my book yet so I'll explain. The Poor Man's James Bond deals with improvised weaponry. The dedication is to three people who used guns in assassinations. The idea is that their misuse of firearms could lead to gun controls which could cause sales of books on improvised weaponry to soar. (Ted Kennedy's gun control proposals have also stimulated interest in alternatives to conventional weapons).

To anyone with my book, the humorous intent is obvious. I don't believe for a minute that Adams saw anything wrong in my dedication. It is clear to me that in my book, he saw a threat to his little organization of paper-patriots. I'll explain this further along.

Adams and his sorry kind are all over the country. They prey on people who are worried about the excess of our creeping bureaucracy. They inspire fear of an imminent takeover, confiscation of guns, etc. Then they get you to hate your government and suspect its legally authorized law enforcement agents of being disloyal to the Constitution.

Always there is the idea that only they know the answers. If you support them you will be informed and organized and, just in time, they will lead you out of the dark into a new era of freedom.

As you continue to read their propaganda, you believe more and more things that don't seem reasonable to others around you. Finally you are cut off, isolated from your fellow Americans. Then only Adams and his kind speak your language. Only they are left to protect you from the red agents and "ATF Gestapo".

So you keep supporting people like Adams. Nothing happens. This is because nothing is supposed to happen. You are just to keep buying subscriptions to The Armed Citizen News and making various donations as old "enemies" fade away and they dig up new ones so as to keep you excited.

But what's wrong with this? Really? What does it matter if he has you and a few other suckers supporting him? Well, it matters a great deal, for several reasons.

First, since he has cut you off from all appeals to reason, you represent a segment of the American population who has been politically castrated, neutralized. You hate your government and its law enforcement agencies. You are just as terrified of the FBI and the ATF (Treasury, Alcohol, Tobacco and Firearms) as any communist subversive.

And like the communists, you find yourself speaking only evil of our government and its agencies and even undermining their efforts to maintain order. The Kremlin doesn't need agents here any more.

The FBI and ATF rely for a major portion of their information on tips by alert citizens. If you see subversion being carried out in your community you are supposed to go to them and report it.

The Leftists are stockpiling illegal arms to a much greater extent than are the Rightists. People like you are in a better position to recognize such activities than most citizens. But if you hate and fear the FBI and ATF and refuse to communicate you intelligence you are helping the Left to arm against your own kind. That makes you a traitor.

But you may even believe that the dealer in illegal weapons is a patriot. If his weapoms are illegal he is a criminal and a criminal's politics are no concern of yours or mine.

If you are confused about illegal weapons send 25c to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Ask for "Firearms Identification" Publication 674.

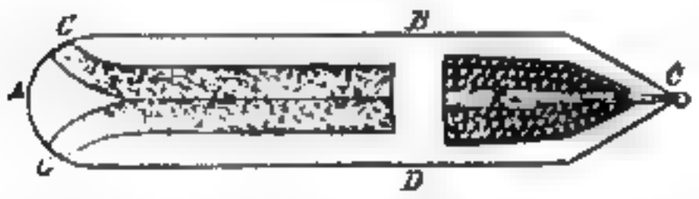
This booklet will show you what the Alcohol, Tobacco and Firearms agents are looking for when they quiz gun collectors. You can see that most of these weapons are about as dangerous to the user as to the intended victim.

They are mainly sawed-off shotguns and zip-guns used by punks in holdups and for plain murder. Hardly weapons needed to resist tyranny.

The range of the best constructed rifled ordnance, at the present time, I believe, is about five miles. Numerous devices are being made to improve the rifling of the bore of the gun and also the expanding appliances of the projectile adapted thereto, in order to secure precision of flight and to extend its range The great resistance which it is known the atmosphere presents to cases of very great projectile velocities, will always tend, in cases where a single projectile force is applied (as in the ordinary mode of projection), very considerably to limit the ultimate range, and also to reduce the force of percussion at the intermediate points where the velocity is the greatest. The effect of this resistance, according to Hutton, reduces the flight of the projectile to about one-tenth of what it would be if the atmosphere did not interpose. The following proposed improvements are therefore designed to be applied to projectiles so as to compensate for the resistance of the atmosphere during their flight, and to preserve, as far as practicable, the initial velocity, and if possible to increase and accelerate the same. For this purpose two distinct modes are suggested, which, it is believed, may be used separately, or the two may be combined together as hereinafter described and illustrated.

The oblong projectile, constructed with the usual external appliances, to be fired from a rifled gun, must in both the modes of improvement here referred to, be formed or constructed with a suitable cell, chamber or barrel, in the tail or rear end of it, the same being made concentric with the axis thereof. In the first method referred to, I propose to fill the said chamber or barrel with rocket composition, so that after the projectile, thus prepared, shall be discharged from the muzzle of the gun, a new and auxiliary propelling force shall be made to act upon it, to counteract, in some degree, the resistance of the atmosphere, and thereby to preserve the initial velocity and force of the projectile during its flight. I have not as yet satisfied myself as to the most appropriate form or figure in the detail, which should be given to said chamber or barrel to answer most advantageously the purposes contemplated, but the general outline thereof, it is presumed, may be sufficiently illustrated and explained so as to be generally understood by the following diagram, Fig. 1, wherein A B C D, represents a longitudinal section of the body of a cylindrical-conoidal shot or shell, the external expanding portion thereof being omitted in the sketch. The chamber, E, in the head of the projectile may contain the explosive charge of powder, balls, &c., to be ignited by the cap on the nipple, C, when the same strikes any object. The chamber or barrel, F, above alluded to in the construction of the proposed projectile, may contain two or more rockets, or the composition thereof, packed therein, having their vents or chokes, terminating at G G. It will be understood

Fig.1



that these vents or chokes, whether two or more in number, must be formed and arranged so as to be at equal distances apart around the exterior end of the projectile, so as to preserve an equilibrium of action around the axis thereof. This inclined action of the inflamed gas on the atmosphere, to propel the shot or shell forward in its course, as here suggested, cannot sensibly be affected by the partial vacuum which is known to exist in the rear of a projectile, when in very rapid flight, as the action in this case would be toward the sides of the projectile, where there must necessarily be a full medium. In fact it will be seen that the point proposed for the action of the inflamed gas is such, that it must meet a volume of atmospheric air pressing inward from the sides of said pro

Then there are the mortars, 75 Caliber machineguns, anti-tank guns and other souvenirs, impossible to supply with ammunition for a battle nowadays.

Most important are the Tommy Guns and illegal automatic M-1 and M-2 carbines, silencers and tear gas.

Fully automatic weapons are terribly wasteful of ammo and not nearly so effective as my legal, semi-automatic 11 shot shotgun, detailed in the Poor Man's James Bond. And why keep a silencer around when my book shows how to make one in a few minutes which you can use and throw away? As for stocking illegal tear gas; my book tells you how to make it for pennies out of glycerine and Sani-Flush. You can shoot it from a water pistol or nasal spray. It's just as good as Mace and although illegal, you can make it within an hour of its use and just throw it away when your need for it has passed.

As you will see from reading the booklet on firearms identification, gun lovers and those who keep guns for self-defense have no use for the kind of weapons the ATF agents are looking for.

Anyone who gets rousted by them asks for it. Thanks to people like Adams, the ATF victim appeared furtive, hostile, evasive, impolite and uncooperative. This will gripe the hell out of any Law officer anywhere in the world. You show hostility to a watchdog and you'll get bit. Show hostility to the ATF or FBI and you're going to get screwed over; I don't care what their training manuals say

On the other hand, if you are friendly with them and show them what you've got you will find they are really nice guys and you'll feel a lot more secure. If you cooperate and should unknowingly have something illegal they will just confiscate it and that's all. They have neither the time nor the inclination to frame you.

If you have something illegal which you really think is essential to your survival, bury it. The Poor Man's James Bond tells you how to beat metal detectors.

A visit by the Federal men may make you think you are the victim of an informer. You could have been sold out by some brainless punk you've been running with. People in nut groups are notorious for throwing each other to the wolves. But what usually leads them to you is your name on the mailing list of a group which is hostile to the U.S Government and its law enforcement agencies.

When they see you are a subscriber to monthly publications sent out by such organizations as the the National Association to Keep and Bear Arms, The National Socialist White Peoples Party, The National States Rights Party, etc., they see you as one who hates our government in general and the FBI and ATF in particular.

So if you are mixed up with some anti-government nut group, they just plain don't like you, friend.

And they didn't have to steal a name list to zero in on you. Any Federal law enforcement agency can monitor the U.S. Mails. That is, the names and addresses on any mail from any organization can be copied before it leaves the Post Office.

Any hostile group mailing out several hundred pieces per month can be monitored in this way. For instance, The National Association to Keep and Bear Arms mails out its paper without an envelope, bulk rate, Permit 697, name and address. What could be plainer? Even a postal worker knowing an organization's mail could monitor the names, and he might be working for the Kremlin. Who needs an organization's mailing list?

This monitoring is very selective since the FBI and ATF simply don't have the personnel to monitor every organization's mail. But if you subscribe to any periodical which preaches hostility to the ATF and FBI you can be pretty sure they know where you sleep.

Even so, it's not against the law to hate your government. So what if they have your name? So what if they even come around and talk to you?

They sought me out when I belonged to nut-groups. I found them entertaining. When a new ATF or FBI man was being broken in his buddies brought him around to me as part of his initiation. After I got through telling him about the state of the world he was never the same.

Okay, so a visit by the ATF didn't bother me. But what about you? If you have your own business and are a lone wolf and don't care what people think,

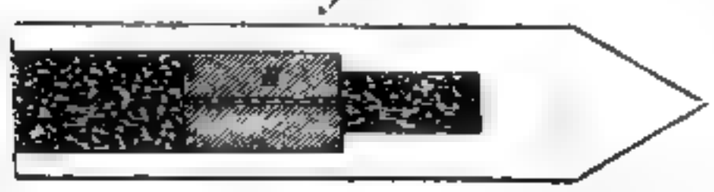
ectile towards its axis, to fill up and restore said void or vacuum as the projectile advances along in its course.

The effect of this proposed application to the projectile, when fired from a rifled gun, we think, must be obvious, if the rifled gun, simply by the force of the charge, can project a ball or shell, say four or five miles, as recent experiments at the Rip-Raps and other places have demonstrated; and, on the other hand, the ordinary military rocket (Congreve) of thirty, forty or more pounds weight, can be projected from a state of rest or quiescence merely by the propelling power of the composition used therein, with a range, it is said, of two or three thousand yards. Is it not plain and plausible, therefore, when these two modes of projection shall be combined together and made to act simultaneously on the same projectile as here proposed, that the result or effect thereof must be greatly increased, and per consequence, that the shot or shell must be sent forward in its flight with greater force and to a greater distance than could possibly be accomplished singly by either of the two modes of projection. The oblique action of the inflamed gas, as here proposed, it is believed, would also be efficient, in some degree, as a propelling power whatever may be the relative velocities of the projectile, and that wherewith the inflamed gas issues from the vents. The construction of the vents or chokes, G G, in addition to their being arranged for propelling the projectile forward in its course, as above suggested, may also be made to terminate at the exterior surface of the projectile, tangentially thereto, so as to discharge the inflamed gas, in a direction contrary to the intended rotation of the projectile, and thereby renew and keep up the gyratory motion of the projectile around its axis. It is suggested that probably this mode of action might be used advantageously with projectiles of an oblong form, fired from smooth-bored guns, so as to give to them nearly the same accuracy and range with the rifled guns.

The above embraces the first method proposed for the improvement of projectiles. Experiments are said to have been made to fire rockets from mortars, howitzers, &c., but with very partial success. The flight of rockets, even when thus projected, are very uncertain and not to be relied upon. In the arrangement above proposed the rocket principle is applied as an auxiliary to the most approved projectile of the present day, viz., those fired from rifled guns, and when properly constructed and applied must certainly improve the range or force of projection without in the least interfering with the accuracy thereof.

In the second method proposed for the improvement of projectiles, in order to insure more effectually an increase of action of the new auxiliary impulses to be applied to the projectile during its flight, I propose to use the explosive force of gunpowder to drive it along in its course. For this purpose the chambers or barrel on the rear of the projectile may be formed and loaded, as shown in Fig. 2, wherein L is a charge of gunpowder, H a heavy cylindrical shot or plug, with touch hole and priming therein, and F a common fuse, or the rocket composition as above suggested.

Fig. 2



With reference to this proposed arrangement it will be understood that after the shot or shell, thus prepared, has been discharged from the gun, the fuse or composition powder, F, will thereby be ignited, and during the flight burn down to the priming in the plug, H, and thus explode the charge, D. The size of the fuze, or quantity of composition, must of course be timed and regulated so as to cause said explosion to take place at the most advantageous point in the

these agents are a welcome break in the day's activities.

Actually, a routine questioning is usually friendly and doesn't attract attention unless it's done by a particularly dim-witted agent. But if you are on their hate list, that is, if you are affiliated with a group they consider hostile to the government, they can be very nasty.

First, they stop off at your local police precinct. They tell the police what they suspect you of and get whatever the police have on you. The police then promise to keep an eye on you and the agents come over to your place. If you are home it's not so bad. But if you are away at work and they flash their badges to your boss and lead you to a back room for a talk, you won't need to worry about promotions from then on.

If the worst happens and the system starts breaking down so everyone knows it, the camps will be activated. Then the agents will begin rounding up everyone on their hate list, whether on the political Left or Right. If you are on their active list you'll wind up in a concentration camp just like the Japanese Americans during the War. They'll treat you well but a concentration camp is still a concentration camp and you'll be out of all the action, maybe for years.

The best way for you to avoid this is to steer clear of all nut groups and anti-government organizations. If you have been suckered into becoming a member or taking a subscription you can cut loose easily.

Just write the goonies a letter telling them to cancel you subscription and take you off their mailing list. Xerox the letter and send the original by registered mail with a request for the return of the signature of the addressee. That way you can show you have dumped them and you'll be okay.

You might think that cutting loose from them would also cut you off from valuable information. But these paper patriots give out only propaganda; no useful information. They're not worth getting yourself put under surveillance for.

Take The National Association to Keep and Bear Arms (NAKBA) for example. I'd never heard of them before a friend sent me four copies of their paper recently. It was pretty kinky and anti-everything but I figured it would be a good advertiser for my Poor Man's James Bond, since they claimed such an interest in a well armed citizenry.

After they rejected my ad I judged their paper in a different light; biased, certainly, but still accurate. Then it wasn't just an eight-page rag put out by a bunch of paranoid fanatics. I saw now it was a rip-off organization promising action but delivering helplessness instead.

What do you get for your $7.00 membership in NAKBA? A dozen foolishly written eight-pagers telling you how vile and degenerate your government is. You are also expected to believe that the government is going to come and take away your guns any day unless NAKBA keeps up its patriotic fight in your behalf.

There is little variety in their paper; no relief from preaching and warning and keeping score on which politicians are traitors. For laughs, I think, they show an old character riding a horse and giving speeches on the same drivel covered by their paper.

For three dollars more, $10, you can get a membership in the National Rifle Association. You also get 12 $1.00 issues of the American Rifleman.

For years, the NRA, with about a million members, has effectively stopped every restrictive gun law dummies like Ted Kennedy and Birch Bayh have tried to put through Congress. And the NRA's mailings aren't monitored.

This is because the NRA is not a political organization. They know how to be *for* guns without being *against* the government or its lawmen.

Their publication, the American Rifleman isn't the only such newsstand publication. There is Gun Week and dozens of different magazines on guns and your rights concerning them. Yes, friend, there are alternative sources of information, and better, no further than your nearest newstand.

I wrote futher back that Adams considered The Poor Man's James Bond a threat to his organization. I'll show you why this is so.

Adams is working a deal whereby he has a lot of people terrified that without his help their guns are going to be confiscated. No one wants to be defenseless so he gets followers.

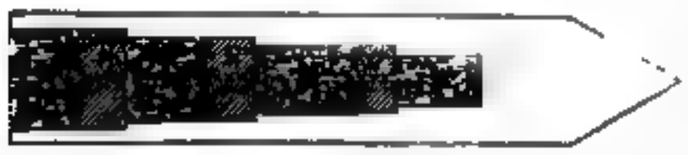
So along comes me with The Poor Man's James Bond. I love guns but my

range thereof. It may require probably, in the first instance, some little skill and practice in preparing and loading this projectile, in order to avoid every possibility of danger of its exploding within the bore of the gun. The cylindrical plug, therefore, should rest and abut on the shoulder of the chamber, L, and fit the barrel, F, as close as practicable and if necessary, may be packed and luted so as to be perfectly air-tight. The fuse, F, to the same end, may be rammed and packed directly into the barrel of the projectile and thus avoid the porosity of the fuse cord.

The action or reaction of the explosive force of the charge, L, as here proposed, must evidently give a powerful impulse to the projectile, which is at the time, moving with a very rapid velocity. To appreciate the amount of this reaction, it will be understood that at the time of said explosion the plug, H, is moving with the same velocity and direction as the projectile itself, and hence must have a momentum equivalent t , its weight and velocity. The explosive force of the charge, L, therefore, to drive said plug out from the barrel of the projectile, must resist and in a measure overcome this said momentum. For example, if the force of the charge, L, was sufficient to give a velocity to the plug (when fired from a state of rest) equal to the velocity of the projectile at the time of the proposed action, it is evident the two forces or velocities would counteract each other, and the plug would fall out of the end of the barrel, as it were, perfectly dead or void of all motion, the gyratory motion of the projectile alone excepted.—Hence, as action and reaction are always equal, the reaction of the explosive force, in this case, to accelerate the velocity of the projectile and drive it forward, would be nearly equivalent to the effect of said explosion acting on and against a solid and stationary body. This reaction on the projectile being in proportion to the momentum of the plug, we may make the plug as large as practicable, to fit the bore of the barrel, so as to obtain the greatest velocity possible. When the projectile is arranged to carry a shell, carcass or the like for bombardment, the loss of weight therefrom by the abstraction of the plug, &c., from the body of the projectile would not be objectionable.

The above illustrates the mode proposed whereby one single explosive impulse may be given to the projectile during its flight, to increase its velocity and range. It is believed practicable, however, by increasing probably the length of the projectile and making the size and power of the rifled guns suitable thereto, to multiply the number of auxiliary impulses to the projectile, at pleasure. Thus in Fig. 3 is shown an arrangement whereby three successive impulses may be given to the projectile during its flight. H H H represents the several plugs, L L L

Fig. 3



the charges or gunpowder, and F the fuse or composition, as before mentioned. In this arrangement the primings may be the fuse or composition powder, which burns slower than gunpowder, so that the explosion of the several charges, L L L, may not be instantaneous, but in succession at certain intervals to be regulated by the quantity and quality of the priming. When a power is constantly acting on a body in motion, as gravitation for instance, the velocity of the body becomes uniformly accelerated. In the case of the projectile before us, after the same should be projected from the gun, the power proposed to act thereon, would not of course be a constant power, but one acting at certain very small intervals of time, the effect therefore would be analogous, and each new impulse would tend to increase and accelerate the previous velocity of the projectile.

book details alternatives, improvised weaponry anyone can put together no matter what kind of people are in power. After all, if you have a gun, you are simply a man with a gun, no better than another man with a similar gun. But with The Poor Man's James Bond, you are an army.

Keep your guns if you can, but be assured that if you should lose your guns, The Poor Man's James Bond would make you even more dangerous to an enemy than if you only had guns.

This is why The Poor Man's James Bond is a threat to Adams and all the other paper patriots. If you have my book you don't give in to the paranoid fears of confiscation. With the Poor Man's James Bond you don't need their help. You can be independent of paper leaders. You can't be disarmed as long as you have my kind of knowledge.

Even so, let's examine this confiscation threat. Such nonsense has been bandied about for years by people like Adams.

But opposing this threat are the Winchesters, Remingtons, Smith & Wessons on down to the manufacturers of the little Saturday Night Specials. Then there are the international dealers who supply us with our Mausers, Lugers, modern Carl Gustaf Sportsters and the companies who scrounge every battlefield on earth to bring us our love objects.

I'll bet they enjoy scare propaganda, hoping it will panic us and make us rush out to buy more guns. And we do. As far back as 1970 the National Rifle Association estimated that there were 200 million guns in civilian hands in the U.S. By now it's probably 50 million more. Most Americans who will own a gun want several.

Guns are a multi-billion dollar business each year and Americans love guns. American civilians own more small arms than are possessed collectively by all the armies and other civilian populations on earth. That's the way it ought to be and that's they way it's going to stay.

They could no more confiscate our guns than they could confiscate our tobacco or our booze. There is just too much money involved. Too many gun lobbiests haunt the Senate.

But just for the fun of it, let's say the government should start clamping down on our gun freedoms. The first act would be registration of all firearms. Most gun owners would simply deny that they had any guns, or they would report them stolen. Very few Americans would register their weapons on order. If a man had 20 guns he might register two. He would bury the other 18.

Americans simply will not be seriously hassled about their guns. This country doesn't have a big enough army to forcibly collect our guns. And as far as giving them up on orders from ATF agents, forget it.

The Nazi would say, "Those niggers armed to the teeth I ain't giving up *my* weapons so up yours and White Power!" The Jewish Defense League: "Me give up *my* weapons with those Nazi bastards all over the place? Never Again!" The Black Panther: "Them honky-Klan muthas ready to shoot my ass off and you want my artillery? Power To the People and Sieze the Time. Up against the wall, pigs!"

Then of course, the ensuing black market in guns would make our criminal class the wealthiest element on earth. They, alone, would be sufficient to make sure that everyone had a gun who wanted one, or two, or three.. ..

So registration is a farce and confiscation is an impossibility. The rank and file would not cooperate and the fanatics would start shooting.

So here you are, a citizen in the most violent country in human history. You're sorting yourself out and finding your place in this great Independent Citizen's Army. You've come a long way and you're getting ready for the revolutions and chaos ahead of us.

Now once you've progressed beyond the nut groups, the paper patriots, the propagandists, you are a lot more aware of things. Instead of wasting your energies through a bunch of paranoid jerks, you can now join legitimate gun clubs and such. Then you won't feel alone and *helpless like you did when* the goonies had you isolated.

You can be sure your name won't get on some ATF hate list. I don't show my mailing list to the authourities. They would be of no value to the government, anyhow. This is because interst in such subjects is shared by most

How far it would be practicable to project a shot or shell with this proposed arrangement, may probably be calculated by some of the known formula in gunnery; its solution, however, would be most satisfactory by a few practical experiments. The projection of shot or shell beyond the limits of vision may at first appear of doubtful utility, we believe, however, that when the same is regulated and directed by the rigid rules of topography and trigonometry, there would be many cases where the same would be found highly useful and efficient. The improvement, however, it will be readily understood, which has the power to project the shot or shell to the greatest possible distance, must necessarily have power to strike nearer objects with the greatest possible force. The rapid introduction of steel-clad armor to vessels of war, and the impunity with which they can face and defy the most powerful ordnance of the present day would seem to demand some improvement in the force of projectiles in order to oppose and resist them. In all new inventions, should imperfections exist, practice will generally point out the defect and supply the remedy.

The barrels or chambers in the projectiles above proposed, as we have already stated, should be made concentric with the axis thereof. The recoil of a gun being known to be always in the line of the axis of the bore thereof, the proposed explosions in the projectile cannot therefore deflect the same from its intended course or aim. In addition thereto the rapid gyratory motion of the projectile, or its *vis vive*, tends also to counterpoise the inequalities in the density of the projectile and the component parts as herein suggested, and also to resist the inequalities, should they exist, in the explosive action of the charges therein.

CHARLES POTTS, C. E.

Trenton, N. J., Dec. 2, 1861.

Trenton, N. J., Dec. 2, 1861.

[We publish the above communication as it is written, but we must inform Mr. Potts that a vacuum in the rear of his projectile would not prevent the rocket composition from propelling the missile forward. If the composition were in a closed chamber, the gases resulting from the combustion would press against the walls of the chamber equally in all directions; but if an orifice is made in the rear by which the gases may escape, the pressure in that direction is removed, and as the pressure against the opposite wall of the chamber continues, the projectile is driven forward. A Barker mill or an Avery engine will run in a vacuum.—EDS.

Americans to some degree. Millions have had military training and even in guerilla warfare. An interest in improvised weaponry is just a natural outgrowth of a normal interset in guns.

Besides, book dealers' mailings are irregular and monitoring campers and hunters would be a lot more tedious than monitoring anti-government types. For these reasons alone, book dealers' mailings would not be monitored.

Nut groups, however, with their regular mailings of hundreds or thousands of easily recognized pieces, are easy to monitor. An agent has merely to go to the Post Office on the day the goonies unload their mailings. He just sits down and works away at the stack until he's copied down every name and address there.

So I repeat; just cut loose from any nut groups. Be your own man. Get a few friends together and map out your own neighborhood defense program. Subscribe to publications like The American Rifleman and Gun Week. Buy books on military science, improvised weaponry and survival. Store food, weapons, ammo and chemicals.

Investing in such commodities is much better than keeping your money in a bank. They are certainly better than silver. When the chips are down you couldn't get a can of beans for a ton of silver. Also, hoarding silver just invites robbery. One the other hand, bullets of all kinds can and will be used for barter.

A man with a closet bullet factory can insure himself of everything he wants when the crash comes. Buy reloading equipment and the overall components for various kinds of bullets. With a good stock of bullets you can always trade them for what you don't have and also use them to defend yourself and your family.

In your preparations for survival, always keep legality in mind. It would be a pity if you planned so well and then get thrown into the pound for breaking the law. That's why I stress legality so much.

If you have any illegal weapons you think you can't do without, I repeat, bury them, preferably in a place where, if they were found, you could deny any connection with them. This also applies to legal weapons you might refust to register.

It is legal to store chemicals, which when mixed, become explosives. It is very illegal, and very stupid, however, to make explosives now and keep them around.

In case you didn't realize it, all the books I list are legal in fact, all books are legal to own, unless they are stolen. The Poor Man's James Bond is simply knowledge. The fact that the application of that knowledge would surely be illegal now, is beside the point. Feel free to buy it or any other such books on improvised weaponry or military science.

I leave you with this: It may be right to deplore all the arming going on around you. But while you are deploring it, just make sure you are better armed than they are.

Improved Gun Lock.

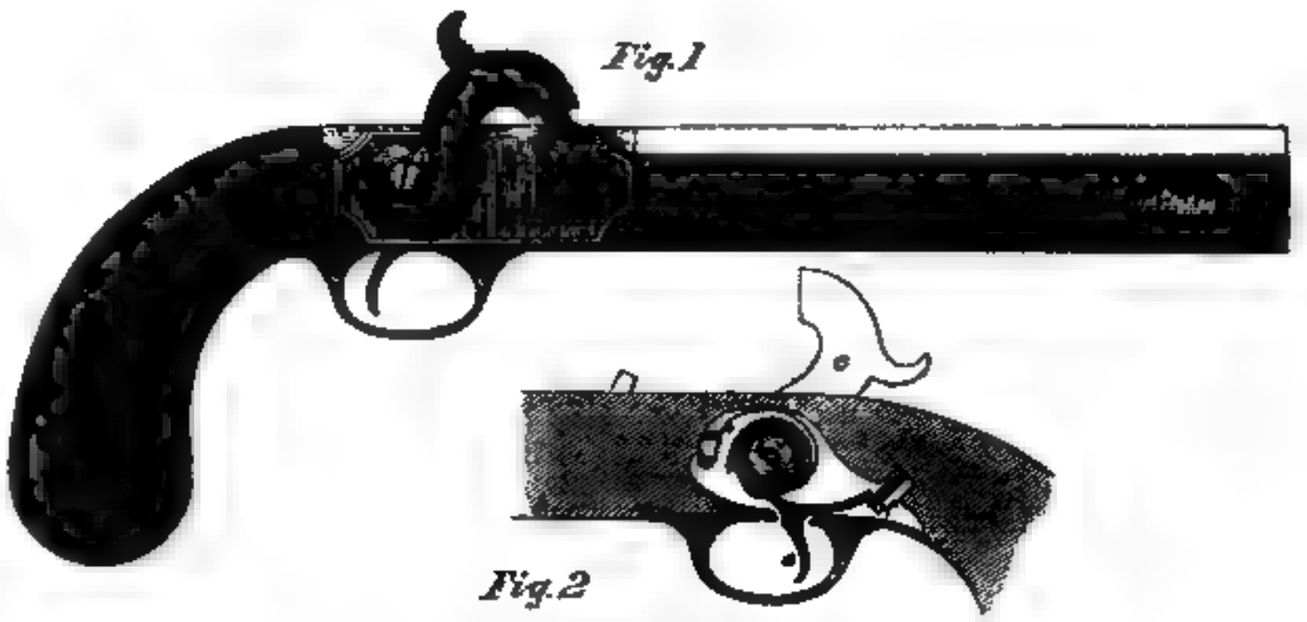
The Scientific American — July 1861

The accompanying engravings represent one of the simplest and most compact gun locks that has yet been devised.

The main spring, *a*, is coiled around the shaft, *b*, to which the cock, *c*, is rigidly secured; the tumbler, *d*, being slipped upon the same shaft, and held in place by a set screw. This mode of securing the tumbler enables the sweep of the cock, or length of arc through which it moves, to be varied and adjusted so as to give a blow of any force desired. The trigger, *e*, is pressed into the notches in the tumbler, by a spring, *f*, which may be spiral, as represented in the cut, or of the usual straight form.

The manifest advantages of this lock are its exceeding cheapness, compactness and simplicity. It is easily taken apart and put together, and if the mainspring or either of its other few pieces should be broken, it could be quickly and cheaply replaced.

The patent for this invention was granted April 30th, 1861.



HILLER'S GUN LOCK.

THE EXECUTIONER'S HANDBOOK

PROCEDURE FOR MILITARY EXECUTIONS

*AR 633-15

ARMY REGULATIONS
No. 633-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *7 April 1959*

PROCEDURE FOR MILITARY EXECUTIONS

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* These regulations supersede DA Pam 27-4, 9 Dec 1947, including C 1, 24 June 1953.

Section I

GENERAL

1. Definitions. For the purpose of these regulations only the following definitions apply:

a. Confirming authority. The competent authority of the agency through which military jurisdiction is exercised ordering the execution of a sentence of death.

b. Officer designated to execute the approved sentence. The officer designated by the confirming authority (*a* above) to execute the approved sentence of death.

c. Officer charged with carrying out the execution. The subordinate officer duly and officially named by an order of the officer designated to execute the sentence (*b* above) and directed therein to carry out the execution.

2. Manner of execution. Military executions will be in the manner designated by the confirming authority or by shooting, hanging, or electrocution.

3. Witnesses. The officer designated by the confirming authority to execute the approved sentence will prescribe whether the execution will be public or private, rules of secrecy as to time, place, and the presence of witnesses, military or civilian, including members of the press if the presence of the latter is deemed proper. In the case of the execution of a foreign national, the officer designatd to execute the sentence will prescribe whether persons of the same nationality as the condemned may be present. Neither photographs nor motion pictures of the actual execution will be permitted except for official purposes. The environs of the place of execution will be closely and securely guarded to prevent the intrusion of unauthorized persons. All persons in attendance will be cautioned that no demonstrations or unseemly conduct will be tolerated.

4. Multiple executions. In multiple executions by electrocution in the continental United States the prisoners will be executed in succession and the same electric chair will be used for each execution. In multiple executions by musketry or hanging, the prisoners may be executed either simultaneously or in succession. Where two or more prisoners are to be executed in succession by musketry or hanging, the same execution party or gallows may be used for each execution. Where two or more prisoners are to be executed simultaneously by musketry, a separate execution party will be provided for each of the prisoners. The latter will be placed in line at an interval of ten paces. Where two or more prisoners are to be executed simultaneously by hanging, the officer designated to execute

the sentence will prescribe the number of gallows to be erected, and the prisoners will be hanged from the gallows simultaneously or by groups.

5. Escort. The escort for execution by musketry or hanging may be dismounted or motorized, but upon arrival at the scene of execution, motorized escorts will form in the manner prescribed for dismounted escorts. The minimum escort will consist of components as prescribed in paragraphs 11*a* and 15*a*. Where the prisoner is to be executed by electrocution, the strength, formation, and duties of the guard escort will be as prescribed by the officer charged with carrying out the execution.

6. Chaplain. In all executions, a chaplain of the prisoner's choice will be provided if practicable. If no chaplain of the prisoner's choice or of his particular faith and/or race is available, the

officer charged with the execution of the sentence will take all reasonable measures to provide a civilian clergyman of that faith and/or race. The chaplain should be available at all times after the prisoner is notified of the time of execution.

7. Medical officer. A medical officer will be officially designated to be in attendance upon the execution. It will be his duty to determine the extinction of life in the prisoner and to make pronouncement thereof. He will furnish a death certificate to accompany the report of execution.

8. Interpreter. In the event the prisoner does not speak English, an interpreter will be officially designated to be in attendance at the notification of the prisoner (par. 9a) and the execution. It is his duty to interpret the charge, finding, sentence orders, and any last statement made by the prisoner. Before entering upon his duties, the interpreter will take the oath or affirmation required of an interpreter for a court-martial.

9. Miscellaneous. *a.* The prisoner will be notified of the time of execution no less than 24 hours prior thereto if practicable, at which time the charge, finding, sentence, and order directing the execution will be read to him by the officer charged with carrying out the execution. The chaplain should be present.

b. Unless the exigencies of the situation preclude such action, due notice of the time and place of execution will be given to the next of kin of the prisoner and an opportunity provided for the claiming of the body following the execution.

c. Items of clothing and alterations thereto to be worn by a prisoner to be executed by hanging or electrocution will be as prescribed by the officer charged with carrying out the execution, in

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accordance with the technical instructions of the executioner. A prisoner in the Armed Forces of the United States will be dressed in regulation uniform from which all decorations, insignia, or other evidence of membership therein have been removed. Likewise, no such evidences will appear on any clothing used in burial. Similar procedures may be dispensed with, at the discretion of the officer charged with carrying out the execution (or higher authority) in the case of a prisoner in the armed forces of another nation. A prisoner not within the foregoing categories may be dressed in any clothing available.

d. After the prisoner is notified of the time of execution (*a* above), the commanding officer of the place of confinement will, where practicable, approve any reasonable special request of the prisoner, including special request for food, and permission to have in his possession a Bible, Rosary, or similar religious articles during the execution. Sufficient writing paper and envelopes should be furnished and no limit placed on the number of letters which may be written. All letters are subject to censorship and may or may not be forwarded.

SECTION II

EXECUTION BY MUSKETRY

10. Officer charged with carrying out execution. The officer charged with carrying out the execution will command the escort and make the necessary arrangements for the conduct of the execution. He will—

a. Instruct and rehearse the escort and the execution party in their duties, insuring that all members of the execution party are qualified in the weapon to be used.

b. Arrange for the receipt of the prisoner by the prisoner guard.

c. Arrange for an execution party of eight men and one sergeant.

d. Arrange for a chaplain to accompany the prisoner.

e. Arrange for the presence of a medical officer at the scene of the execution.

f. Cause a post with proper rings placed therein for securing the prisoner in an upright position to be erected at the place of execution.

g. Cause eight rifles to be loaded in his presence. At least one but no more than three will be loaded with blank ammunition. He will place the rifles at random in the rack provided for that pur-

[redacted]

h. Provide a black hood to cover the head of the prisoner.

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i. Provide a 4-inch round target, white or black as appropriate; a black target will be used when light colored clothing is worn.

j. Cause the prisoner's wrists to be secured either behind his back or in front at the waist (fig. 1), before or immediately after his receipt by the prisoner guard.

k. Provide straps to secure the prisoner to the post at waist and ankles.

11. Assembly of escort. *a.* The prisoner guard will consist of four men armed with rifles, under the command of a sergeant armed with a pistol. At the proper time, the prisoner guard will proceed to the place of confinement to receive the prisoner.

b. The execution party will be formed unarmed and proceed to a previously prepared rack of rifles, secure arms, and move to the scene of the execution, halting 15 paces from and facing the position to be taken by the prisoner. The sergeant of the execution party will be armed with a pistol. At close interval, at order arms, and at parade rest the execution party will await the arrival of the prisoner and escort.

c. Witnesses, if any, will take position facing the scene of the execution, 15 paces to the right and 5 paces to the front of the execution party.

d. At the designated time, the prisoner, with his wrists bound securely behind his back or in front at the waist (fig. 1), accompanied by the chaplain, will be received by the prisoner guard. The escort will then proceed to the scene of the execution.

e. The prisoner guard, prisoner, and chaplain will proceed directly to the prisoner's post, halt, and face the execution party.

12. Execution. *a.* The officer charged with carrying out the execution will take position in front of the execution party and face the prisoner. He will notify the prisoner and the chaplain that a brief time will be allowed the prisoner for any last statement. After a reasonable time, he will order the sergeant of the execution party and the sergeant of the prisoner guard to secure the prisoner to the post and to place the hood over his head. The medical officer then will place the target over the prisoner's heart. The prisoner prepared, the officer charged with carrying out the execution will order the prisoner guard to move to a position five paces behind the execution party. The chaplain and medical officer will take positions five paces to the left of and five paces to the front of the execution party. The officer charged with carrying out the execution will take position five paces to the right of and five paces to the front of the execution party.

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b. Commands for the execution will be given orally as prescribed below:

(1) At the command READY, the execution party will take that position and unlock rifles.

(2) At the command AIM, the execution party will take that position with rifles aimed at target on the prisoner's body.

(3) At the command FIRE, the execution party will fire simultaneously.

(4) The officer charged with carrying out the execution will then bring the execution party to "Order Arms."

c. The officer charged with carrying out the execution will join the medical officer who will examine the prisoner and, if necessary,

direct that the "coup de grace" be administered. Should the medical officer so decide, the sergeant of the execution party will administer the "coup de grace," with a hand weapon, holding the muzzle just above the ear and one foot from the head.

d. Upon pronouncement of the death of the prisoner by the medical officer, the execution party will proceed to the rack from which the rifles were originally obtained, and replace the rifles in the rack at random. The execution party will then be dismissed.

e. The prisoner guard will return to the area of their quarters and be dismissed.

SECTION III

EXECUTION BY HANGING

13. Officer charged with carrying out execution. The officer charged with carrying out the execution will command the escort and make the necessary arrangements for the conduct of the execution. He will—

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f. Determine the proper amount of drop of the prisoner through the trapdoor. A standard drop chart for normal men of given weights is given below. Variation of the drop because of physical condition may be necessary. A medical officer will be consulted to determine whether any factors, such as age, health, or muscular condition will affect the amount of drop necessary for a proper execution.

g. Instruct components of the escort in their duties.

h. Arrange for the receipt of the prisoner by the prisoner guard.

i. Arrange for a chaplain to accompany the prisoner.

j. Arrange for the presence of a medical officer at the scene of the execution.

k. Provide a proper gallows.

l. Provide a black hood to cover the head of the prisoner.

m. Provide a collapse board for use if necessary.

120 lbs or less	8' 1"	170 lbs	6' 0"
125 lbs	7' 10"	175 lbs	5' 11"
130 lbs	7' 7"	180 lbs	5' 9"
135 lbs	7' 4"	185 lbs	5' 7"
140 lbs	7' 1"	190 lbs	5' 6"
145 lbs	6' 9"	195 lbs	5' 5"
150 lbs	6' 7"	200 lbs	5' 4"
155 lbs	6' 6"	205 lbs	5' 2"
160 lbs	6' 4"	210 lbs	5' 1"
165 lbs	6' 2"	220 lbs and over	5' 0"

n. Rehearse the execution within 24 hours prior to the scheduled time for the execution. A sandbag or similar object approximating the prisoner's weight may be used to insure proper functioning of the gallows, trapdoor, and hangman's noose.

14. Executioner. An official experienced executioner will be appointed by the officer charged with carrying out the execution. If one is not available to the command, a professional civilian executioner may be obtained and appointed. In the event a professional executioner is not available, a suitable emotionally stable member of the command will be selected and appointed executioner.

15. Assembly. *a.* The prisoner guard will consist of 10 men armed with rifles, two corporals armed with pistols, under the command of a sergeant armed with a pistol. The prisoner guard will form in double ranks and at the proper time will proceed to the door of the place of confinement to receive the prisoner.

b. Witnesses, if any, will assemble at the scene of the execution in positions designated by the officer charged with carrying out the execution.

c. At the designated time the prisoner, with his wrists bound securely, accompanied by the chaplain, will be received by the prisoner guard and placed between the ranks. The escourt will then proceed to the scene of the execution.

d. Upon the arrival of the escort at the scene of the execution, the corporals and the sergeant of the prisoner guard will conduct the prisoner to the platform of the gallows, the officer charged with carrying out the execution and the chaplain preceding the prisoner.

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16. Execution. *a.* The officer charged with carrying out the execution will notify the chaplain and the prisoner that a brief time will be allowed the prisoner for any last statement. After a reasonable time, he will have the executioner place the hood over the prisoner's head, bind the prisoner's ankles, adjust the noose around the prisoner's neck, and then take position at the trigger. Upon signal from the officer charged with carrying out the execution, the executioner will spring the trap. The medical officer will then examine the body for time of death and report to the officer charged with carrying out the execution.

b. Upon the pronouncement of the death of the prisoner, the escort will return to the area of their quarters and be dismissed.

SECTION IV

EXECUTION BY ELECTROCUTION

17. General. Execution by electrocution may be effected only at the confinement facility designated by Headquarters, Department of the Army. Procedures for execution by electrocution will necessarily vary from those prescribed for execution by musketry or hanging.

18. Officer charged with carrying out execution. The officer charged with carrying out the execution will make the necessary arrangements for the conduct of the execution. He will—

a. Select and appoint such personnel, including guards, as may be required to carry out the execution.

b. Instruct all components of the execution party in their duties.

c. Arrange for a chaplain to accompany the prisoner.

d. Arrange for the presence of a medical officer at the scene of the execution.

e. Provide the mechanical facilities and items of equipment and clothing required to carry out the execution.

19. Executioner. The officer charged with carrying out the execution will obtain and appoint a professional civilian executioner to perform the execution. Execution by electrocution may not be performed by other than a professional civilian executioner.

20. Execution. *a.* On the day of execution, the prisoner will be clothed and otherwise prepared in accordance with instructions of the executioner.

b. At the designated time, the prisoner, accompanied by the chaplain, will proceed under guard from the prisoner's cell into the execution chamber. The officer charged with carrying out the exe-

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cution will notify the chaplain and the prisoner that a brief time will be allowed the prisoner for any last statement. After a reasonable time, he will order the guards to place the prisoner in the electric chair according to the instructions of the executioner. Following the placing of the prisoner in the electric chair, the officer charged with carrying out the execution, the guards, the chaplain, and the medical officer will move to designated positions in the execution chamber. The executioner will then perform final preparations. Upon signal from the executioner that all final preparations have been completed and he is ready to proceed, the officer charged with carrying out the execution will signal the executioner to perform the execution.

c. Upon notification from the executioner that he may proceed, the medical officer will then examine the body, note the time of

death, and report to the officer charged with carrying out the execution.

d. Upon pronouncement of the death of the prisoner, the officer charged with carrying out the execution will dismiss the execution party.

SECTION V

PROCEEDINGS AFTER EXECUTION

21. Disposition of remains. The officer charged with carrying out the execution will arrange in advance for an ambulance or other conveyance with sufficient personnel to be in attendance upon the execution to receive and care for the body. If the next of kin or other relatives of the deceased desire the body, the officer charged with carrying out the execution will, if practicable, permit its delivery to them for burial. If no such claim is made, he will cause it to be buried in a post or civilian cemetery or at the pace of death, whichever may be deemed proper and is authorized by pertinent regulations. Disposition of remains of such personnel of the Armed Forces of the United States is governed by Army Regulations of the 638-series or comparable regulations of the United States Navy or United States Air Force as appropriate. All burials in post cemeteries are governed by AR 210–190.

22. Disposition of effects. See 10 USC 4712 et seq. and AR 643–50 or AR 643–55 as applicable. War criminals and civilan resident criminals convicted by a Military Tribunal and executed by military authorities are considered as subject to military law for the purpose of disposition of effects.

23. Notifications and reports. The officer designated to execute the approved sentence will notify The Adjutant General immedi-

h. Cause the prisoner's wrists to be secured before or immediately upon his receipt by the prisoner guard. The wrists may be secured either behind the back or in front, fastened to the belt (fig. 1).

ately following the execution, by fastest available method of communication, of the carrying out of the sentence of death, the time, place and any unusual circumstances attendant thereon. He will likewise, in addition, furnish other notifications as may be required by AR 600–65 and AR 600–66 or AR 600–67. The quartermaster or other officer in charge of burial will furnish the report of burial as required in the regulations cited in paragraph 21.

SECTION VI

MODIFICATION OF PROCEDURES

24. Limited facilities. If the facilities are not available for the carrying out of each of the provisions of this regulation or if the exigencies of the situation require it, the officer designated to execute the approved sentence may make the necessary modification of the provisions herein contained, except that he may not change the mode of execution. Any modification will be reported in writing to the confirming authority.

25. In time of war. In time of war, only the minimum number of troops necessary to accomplish the execution need be employed.

SECTION VII

STRUCTURES

26. Permanent scaffold. A permanent type, demountable scaffold, with a metal trigger mechanism, will be erected when the need for such a structure is determined by the commanding officer (fig. 2). Where available, troops belonging to the Corps of Engineers will be employed in the constructing of the scaffold, but where not available, or where it is more practicable, other troops or civilans may be employed. Preliminary tests will be made to insure the strength of the rope and the stability of the scaffold's construction. If facilities are limited, a trapdoor on the second floor of the building may be constructed to effect the execution, or a similar improvisation employed.

27. Semipermanent scaffold. A semipermanent scaffold which requires no special metal fittings may be used in executions by hanging when deemed expedient by the officer charged with carrying out the execution (fig. 3).

28. Emergency structures. When the exigencies of the field so dictate, emergency type gallows may be used (fig. 4).

SECTION VIII

EQUIPMENT

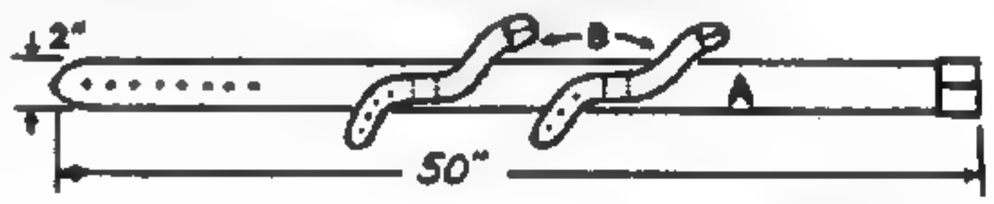
29. Hood. The hood will be black, the outer surface of rough materials, split at the open end so that it will come well down on the prisoner's chest and back.

30. Collapse board and binding strap. A collapse board will be provided for use in case of the collapse of the prisoner (fig. 5).

31. Rope. The rope will be of manila hemp, at least ¾ inch and not more than 1¼ inches in diameter and approximately 30 feet in length. The rope will be boiled and then stretched while drying to eliminate any spring, stiffness, or tendency to coil. The hangman's knot (fig. 7) will be used in the preparation of the noose. That portion of the noose which slides through the knot will be treated with wax, soap, or grease to insure a smooth sliding action through the knot. The noose will be placed snugly around the prisoner's neck in such a manner that the hangman's knot is directly behind his left ear.

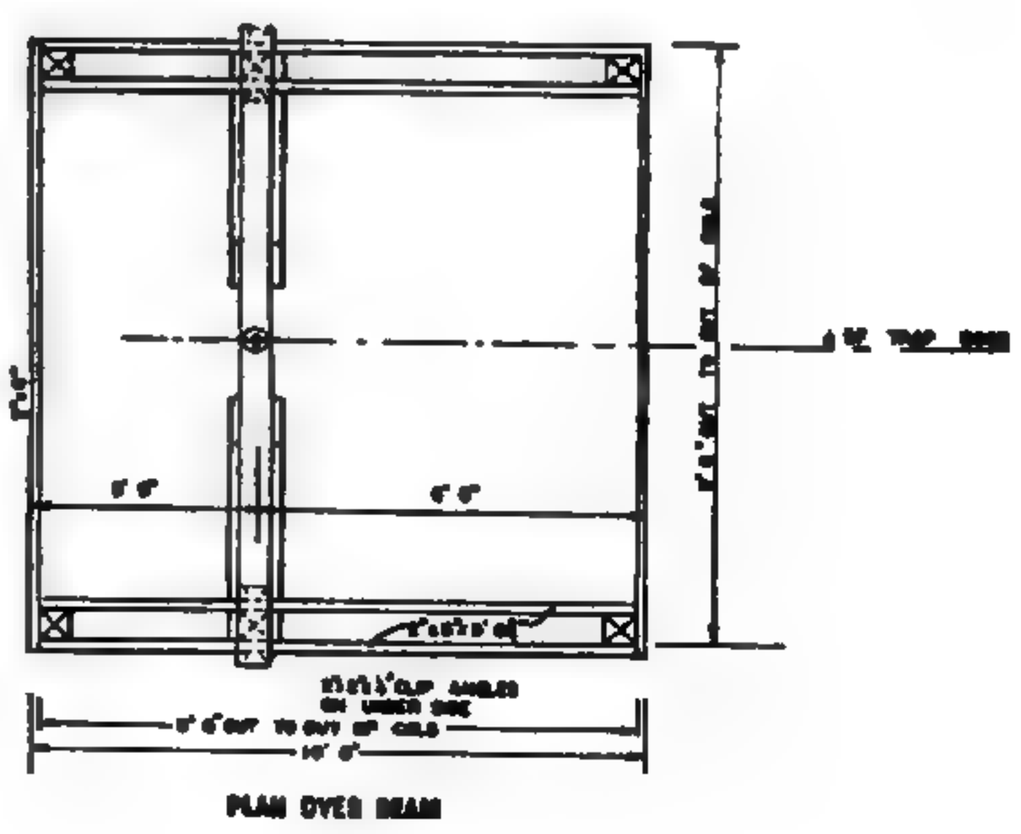
32. Post. Design for post used in execution by musketry as mentioned in paragraph 12*a*, is shown in figure 6.

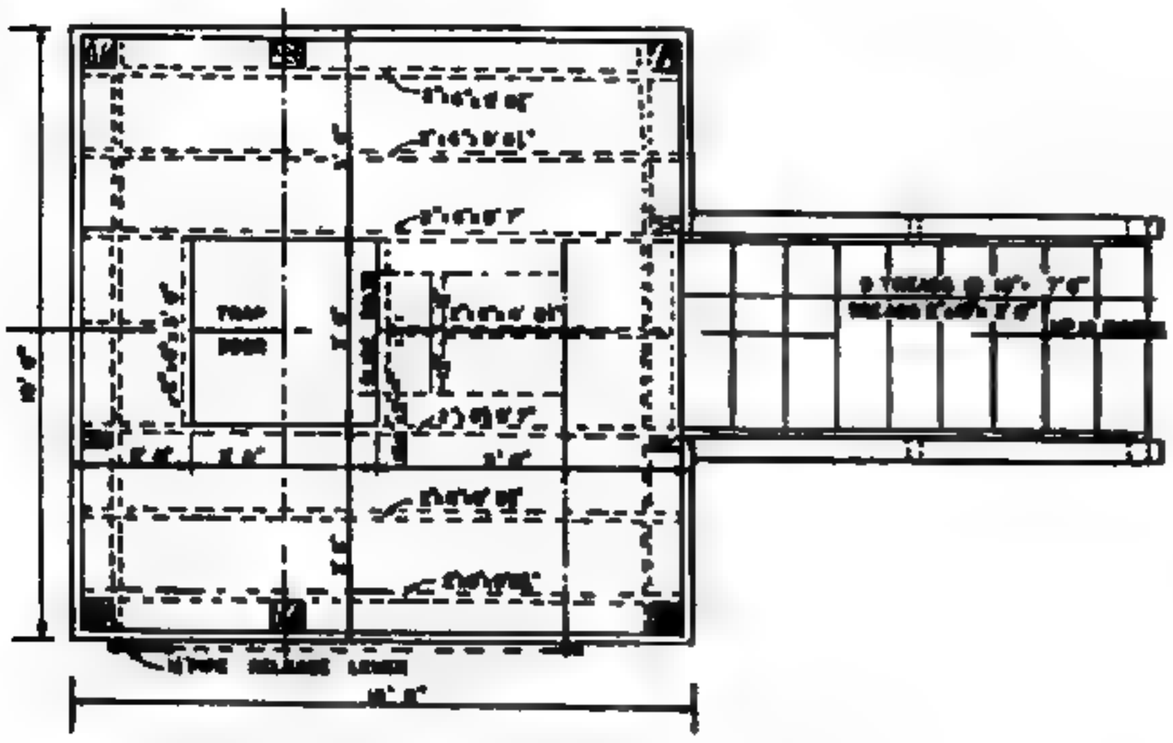
33. Electrocution. Facilities and equipment for effecting execution by means of electrocution will be in accordance with Headquarters, Department of the Army instructions.



A= Body Strap
B= Arm Straps 1"x9"

Figure 1. Binding strap.





PLATFORM AND STAIR PLAN AT SECTION A-A SCALE ½" = 1'

Figure 1 ①. Permanent scaffold.

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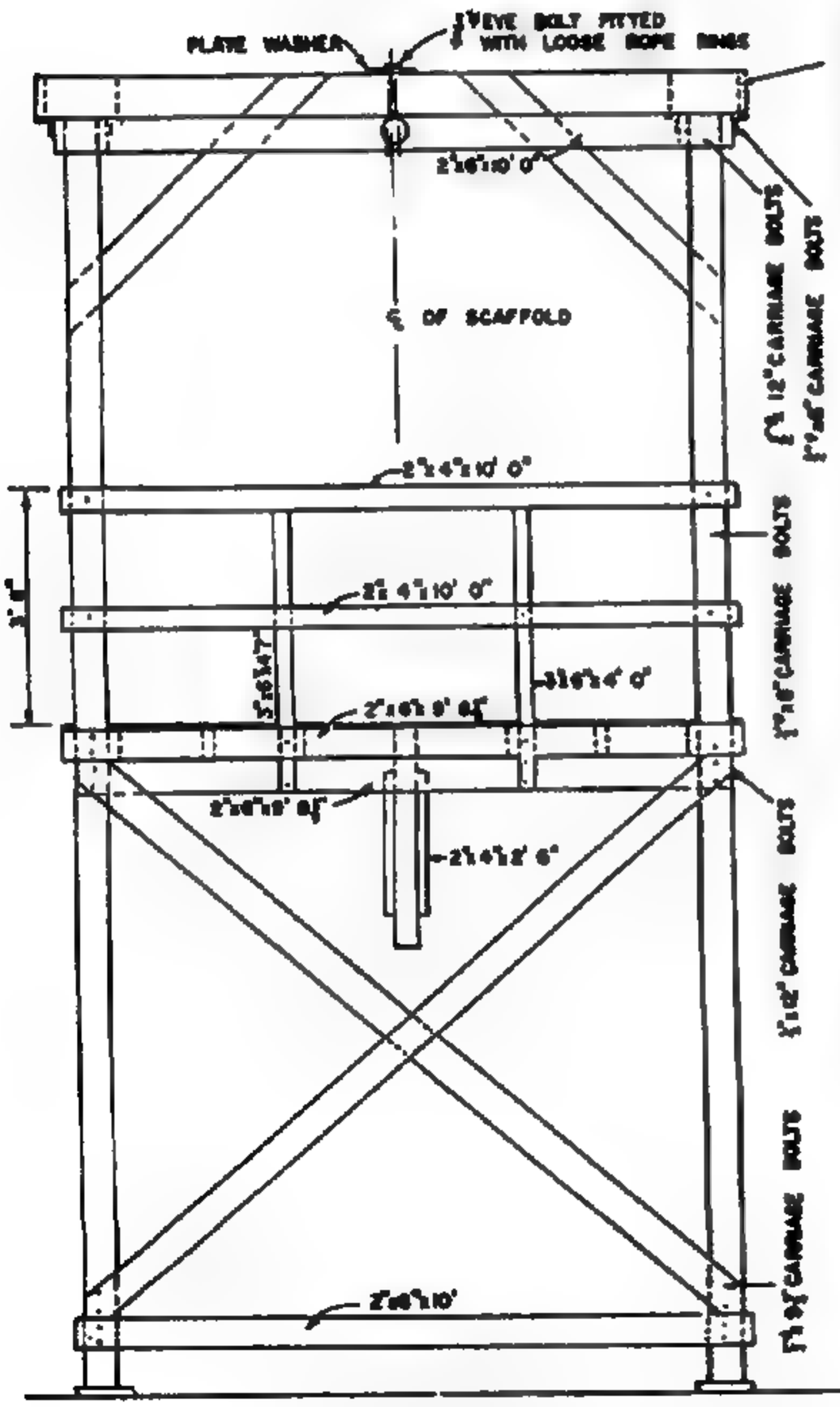

FRONT ELEVATION SCALE ½" = 1'

Figure 2 ①. Permanent scaffold, front elevation.

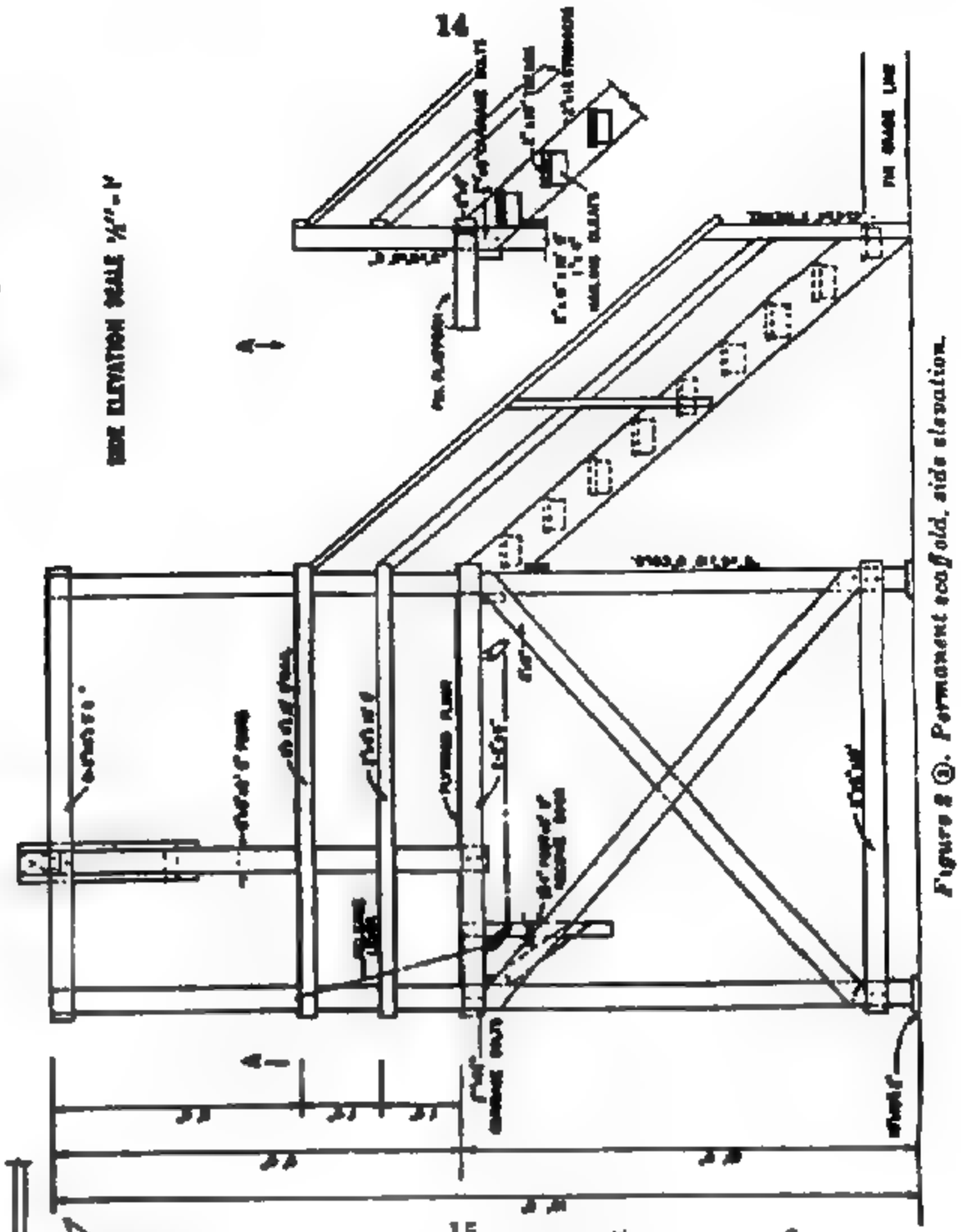

Figure 1 ②. Permanent scaffold, side elevation.

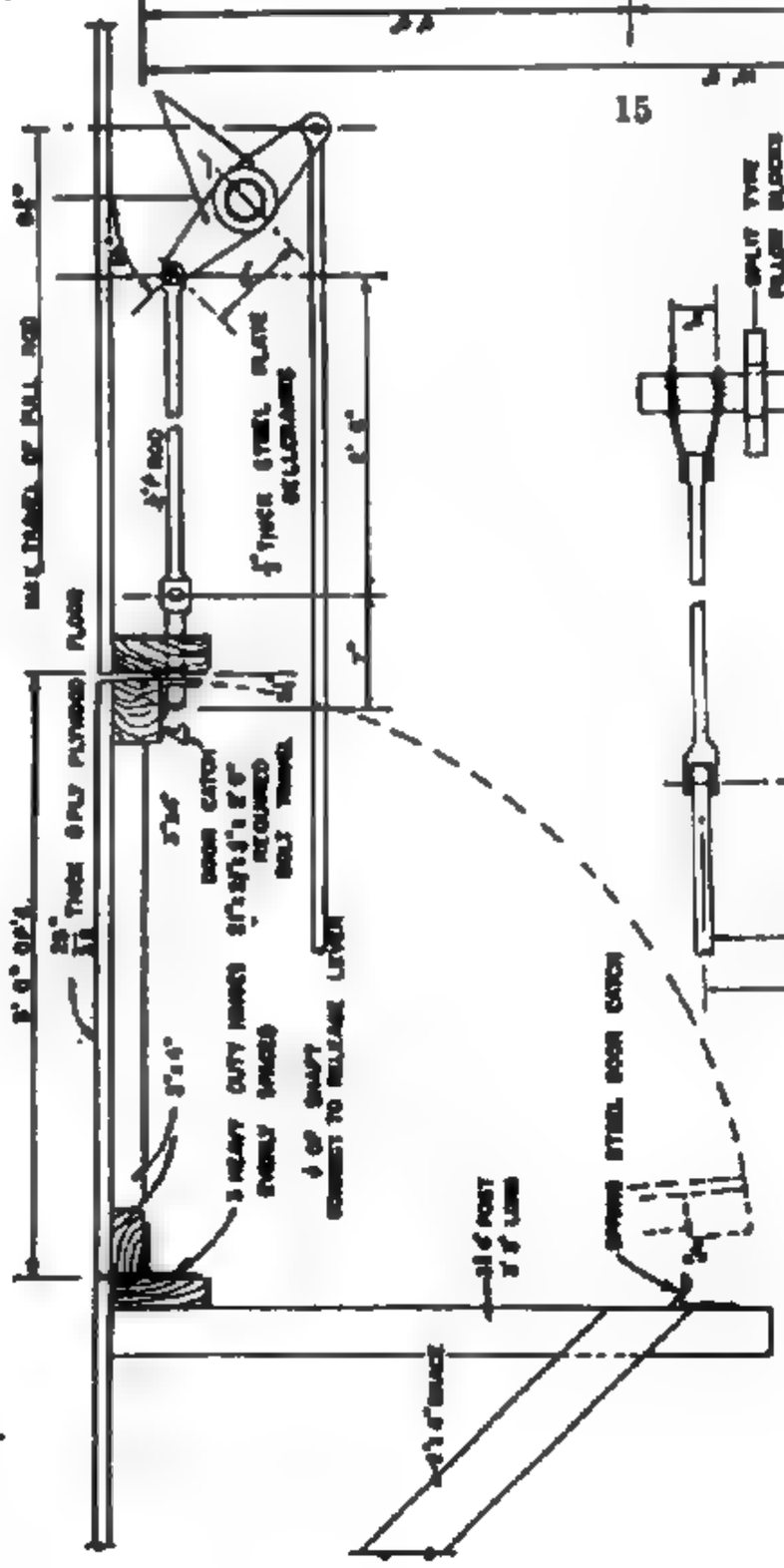

Figure 2 ②. Permanent scaffold, bell crank.

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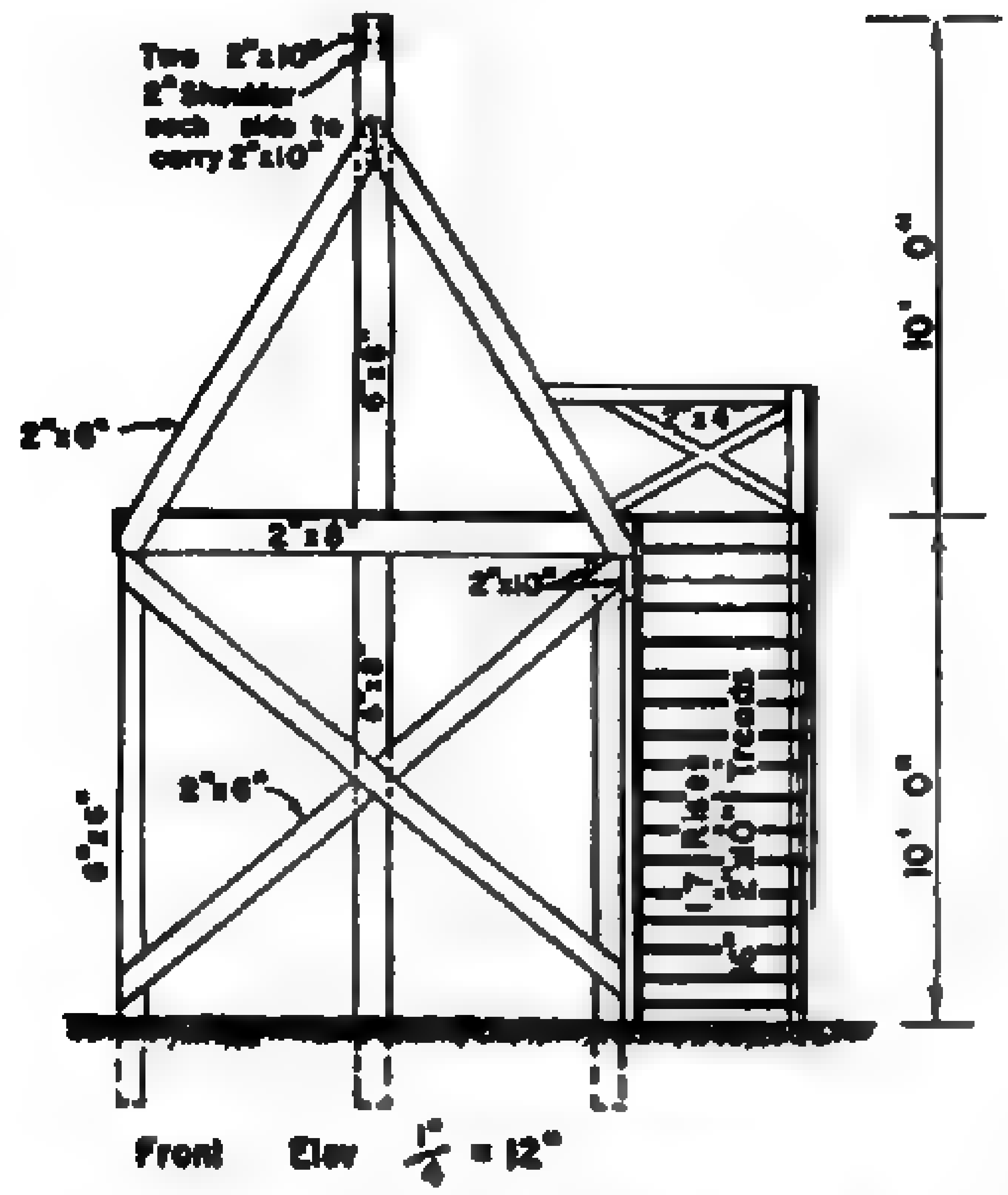
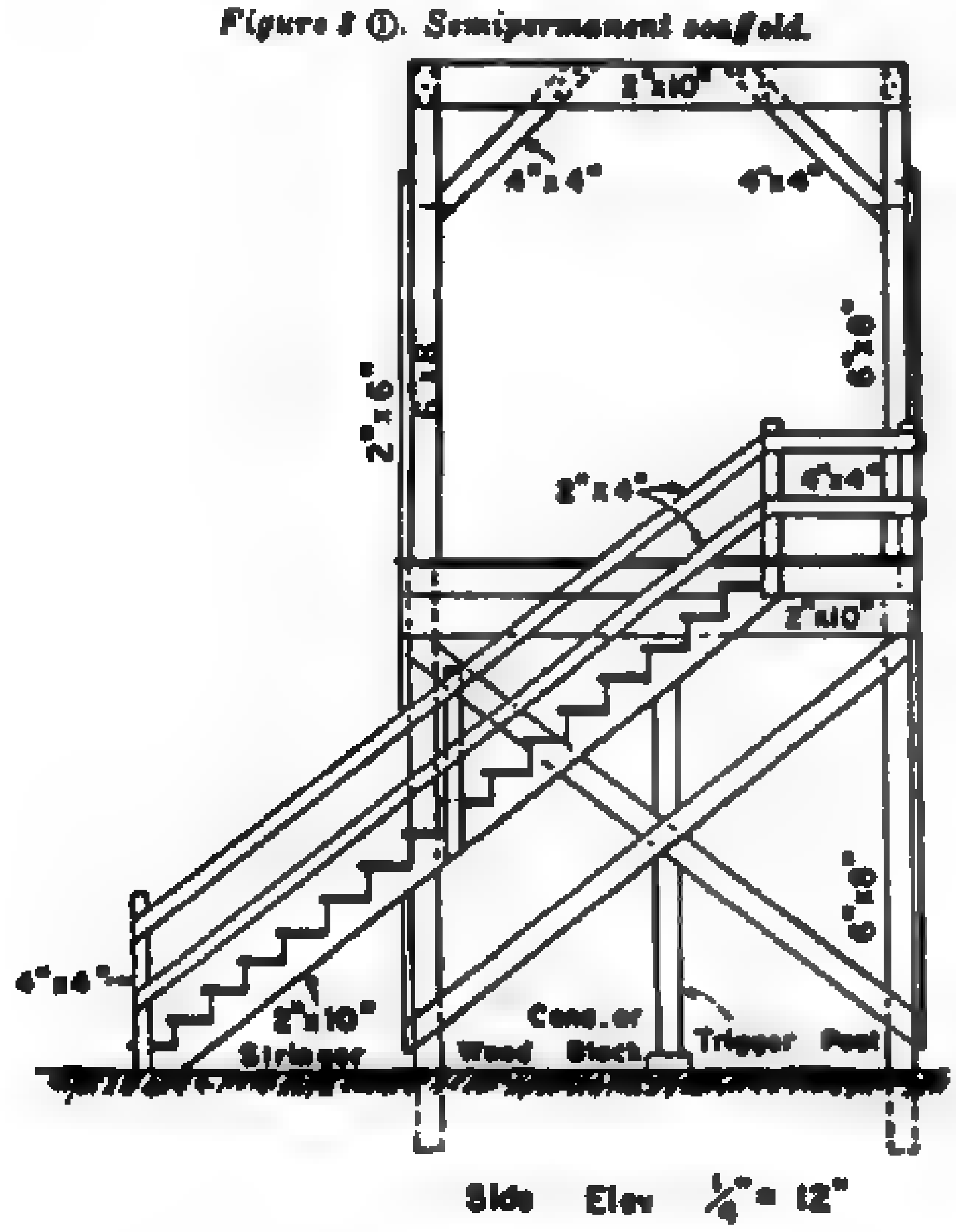


Figure 8 ①. Semipermanent scaffold.



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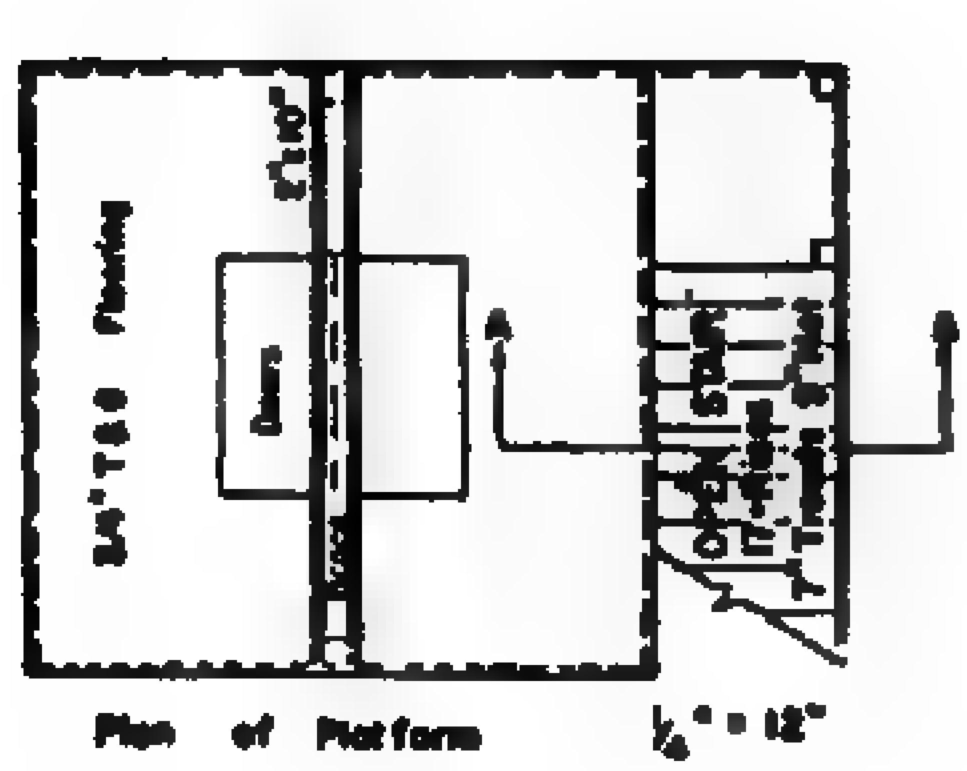

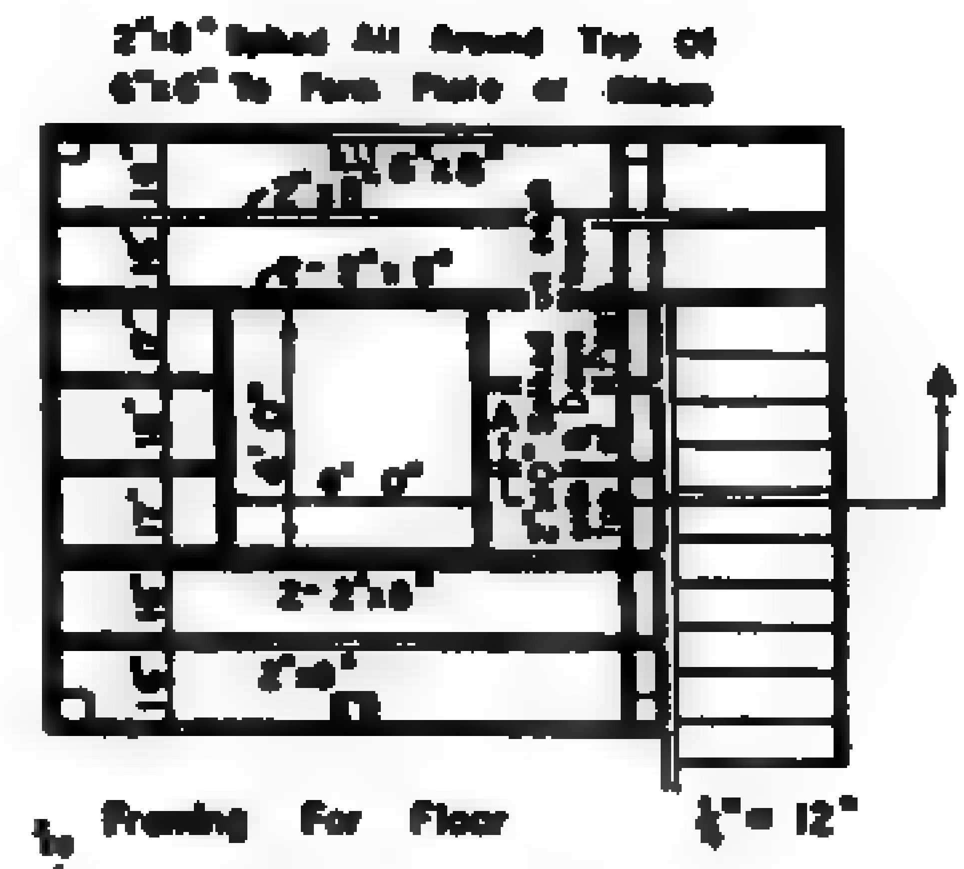

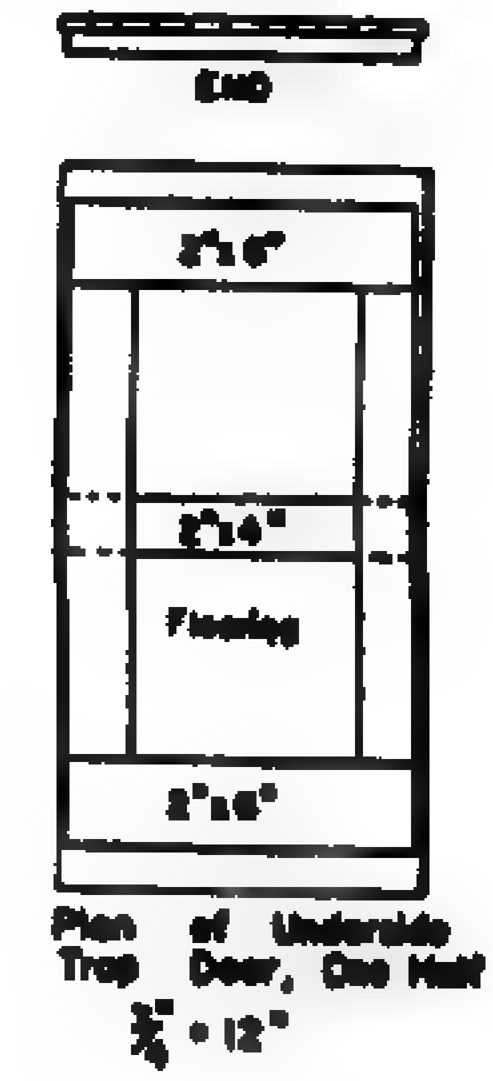

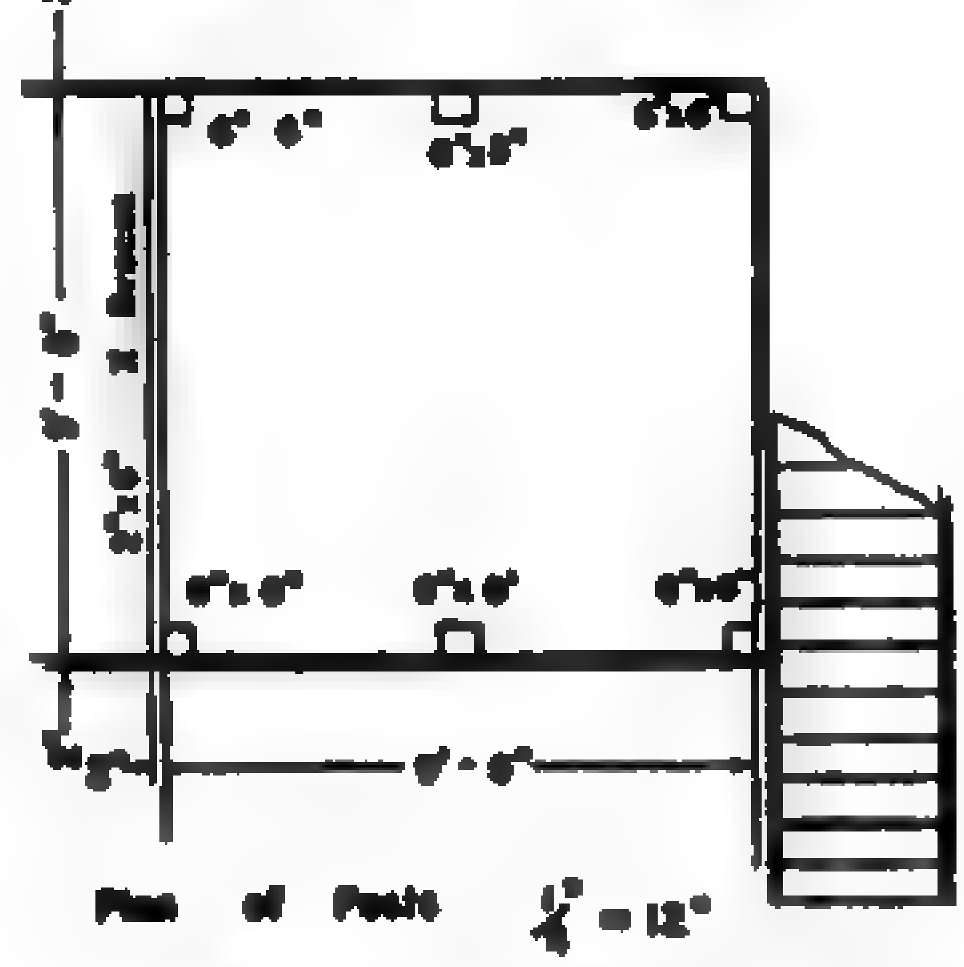

Figure 8 ①. Semipermanent scaffold, details.

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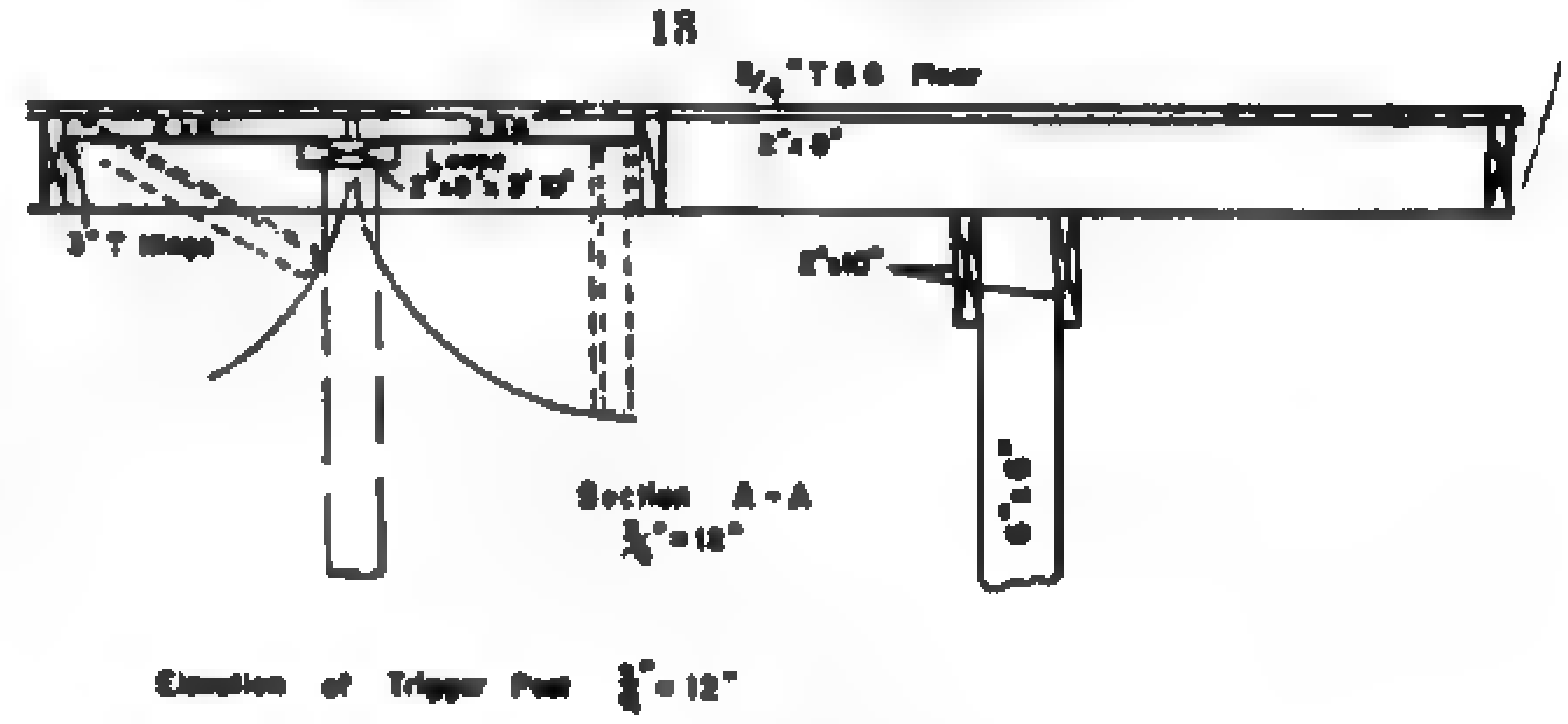

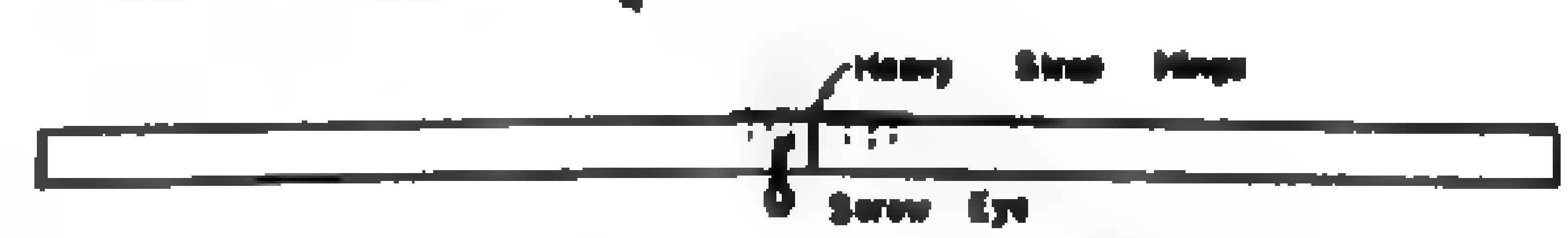

4"x4" 9' 6" Long Cut In Two Pieces At Center

Hinged To Stand with 1-inch Bow At Center

MATERIALS

2 pcs	6"x6" -	22' Long	Gallows Posts
4	6"x6" -	12'	Platform Posts
2	2"x10" -	16'	Step Stringers
4	2"x10" -	10'	Cross Bar - Beam
3	2"x8" -	14'	Joist - Extend for stair landing
1	2"x8" -	12'	Joist - Short
7	2"x8" -	10'	Joists - Regular
8	2"x6" -	14'	X Braces
4	2"x6" -	10'	Gallows Braces
1	4"x4" -	10'	Knee Braces (cut to 6' 0")
4	4"x4" -	4'	Newels
2	2"x4" -	16'	Stair Rail
1	2"x4" -	14'	Stair Rail
3	2"x4" -	10	Stair Rail & Trap Door Rail
(Flooring if 2" stock			10 pcs 2"x6" 12' Long; 6 2"x6" 10' Long; 3 2"x6" 8' Long)
1 pc	2"x6" -	8' Long	Trap Door Rails
1	2"x6 3/4" 8'		140 Bd 3/4" T&G Pine Flooring
4	2"x10" -	14'	Cut into 3' 6" lengths Step Tread
1	4"x4" -	[illegible]	Trigger

Figure 8 ①. Semipermanent scaffold, details—Continued.

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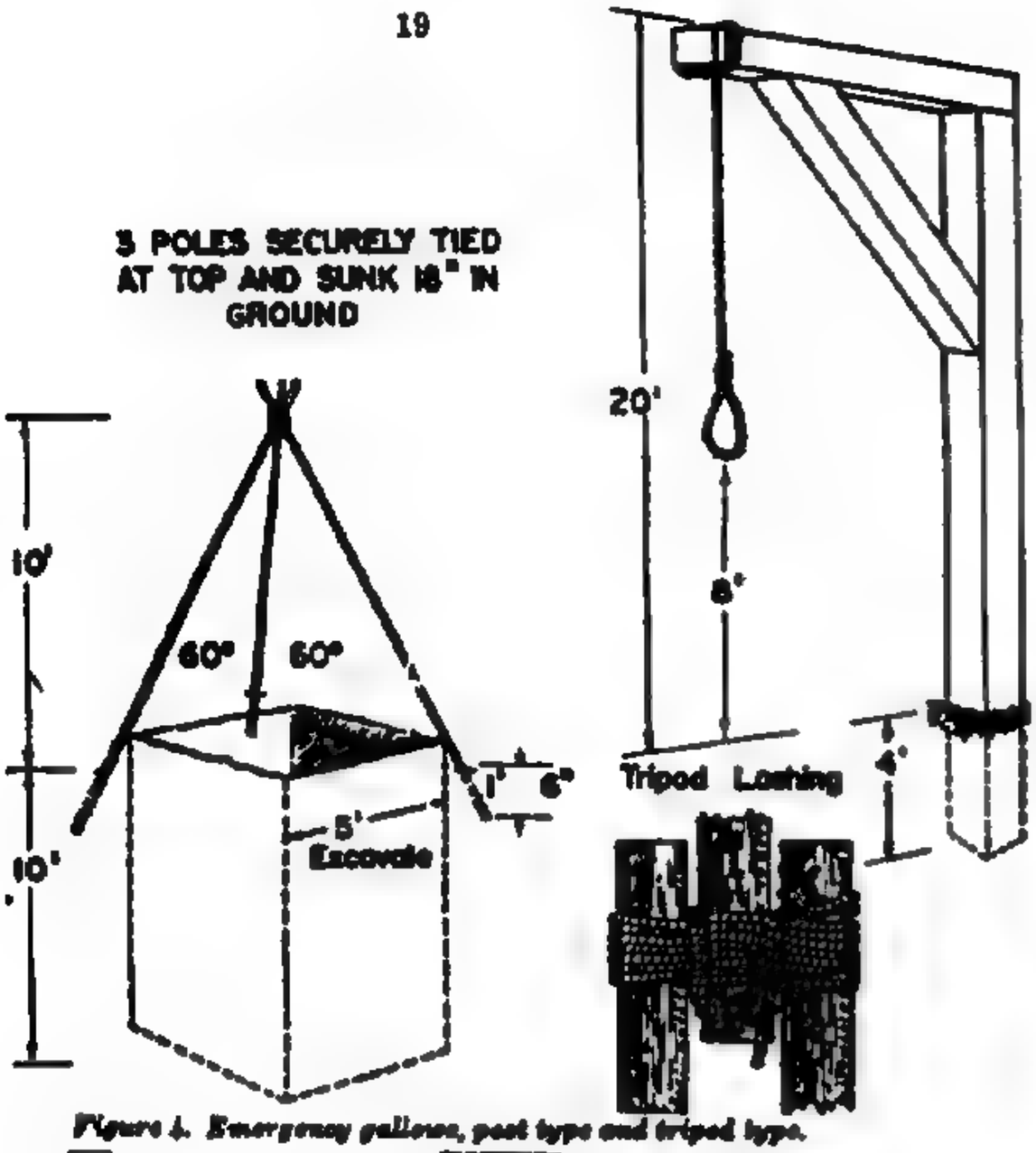


Figure 4. Emergency gallows, post type and tripod type.

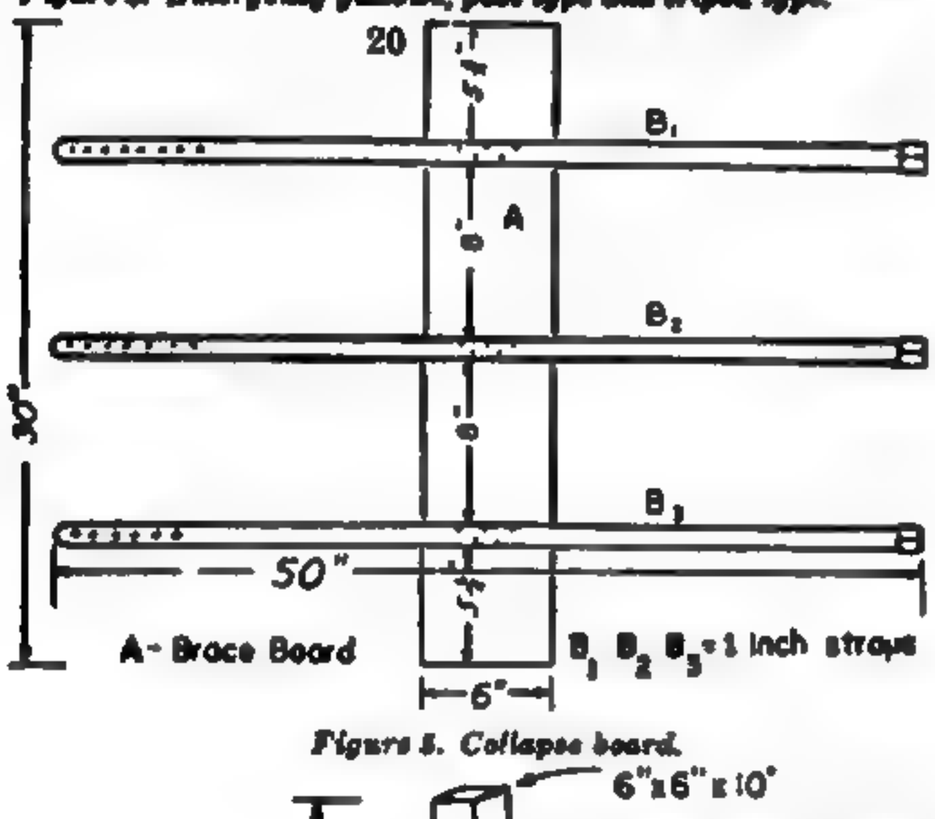


Figure 5. Collapse board.

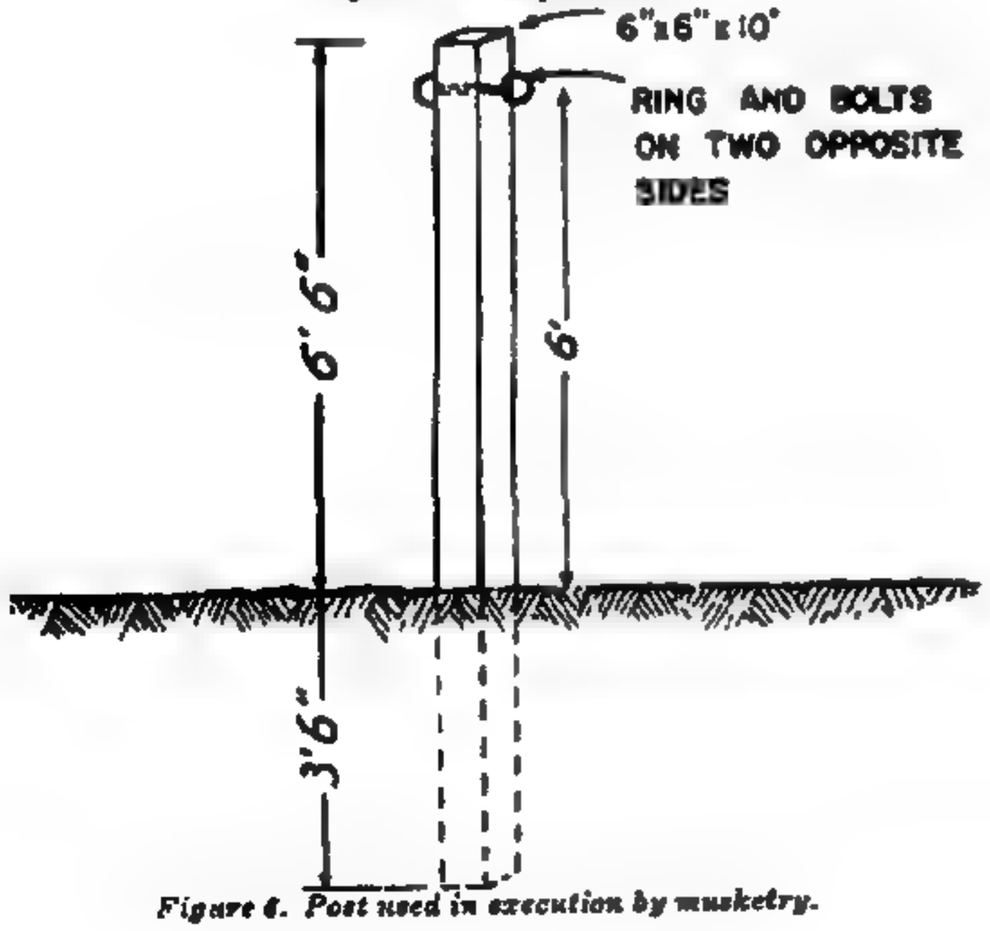
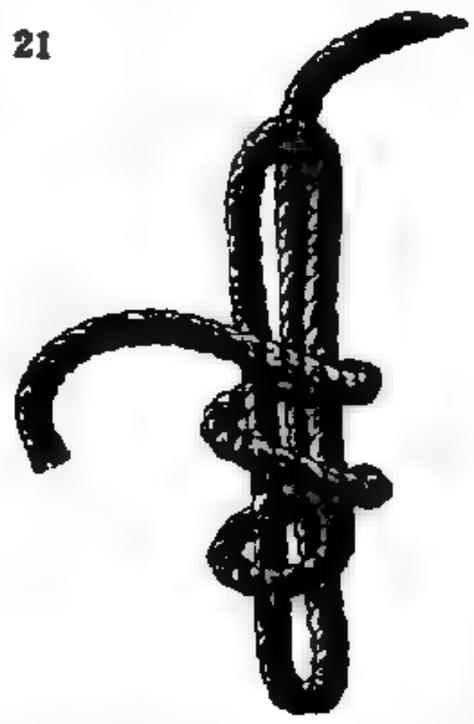


Figure 6. Post used in execution by musketry.

21



Length of loops: from A to B should be approximately 18 inches, and from C to Running End should be approximately 35 inches to 108 inches depending upon diameter of the rope. Wrap Running End around for six turns. No extra rope should remain.

Figure 7 ① and ②. Hangman's knot.

Tighten loops by pulling at Running End. Lock loops and form knot by pulling down at point D. Slide knot up or down on Standing Part to adjust size of loop.

Figure 7 ① and ②.

22

[AG 250 (16 Mar 59) PMGK]

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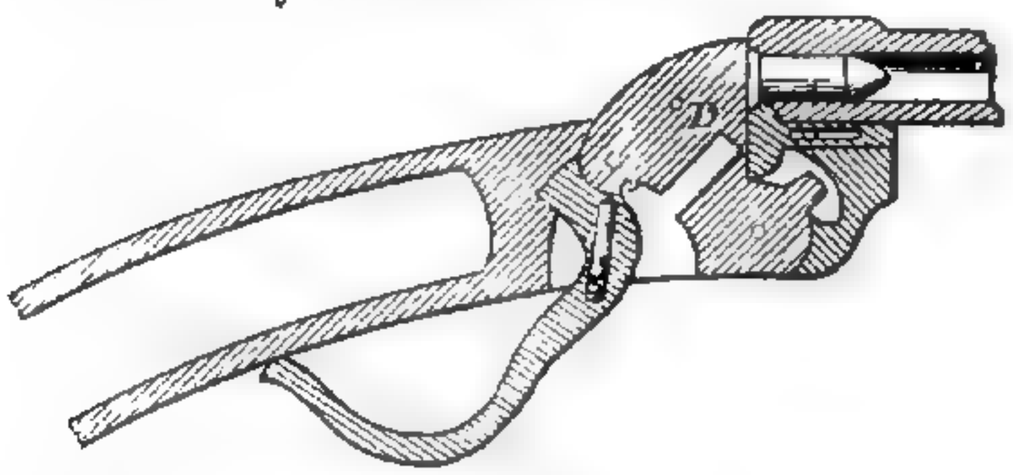
As you read all the entries here, you'll gain a basic familiarity with weapons which will stand you in good stead regardless of what field of weaponry you're into.

— *A* —

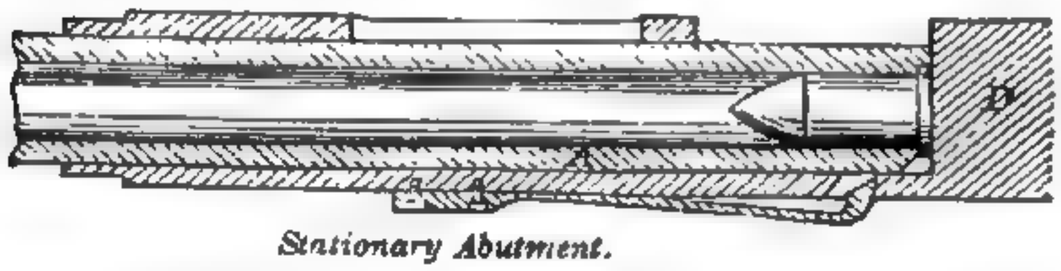
A-but'ment. A fixed point or surface, affording a relatively immovable object against which a body *abuts* or presses while resisting or moving in the contrary direction.



Movable Abutment.

(*Fire-arms.*) The block at the rear of the barrel of a fire-arm (especially a breech-loader), which receives the rearward force of the charge in firing.

It has the function of the *breech-plug* or *breech-pin* in the muzzle-loading fire-arm.



Stationary Abutment.

A similar term is applied to the corresponding portion in breech-loading cannon.

In Fig. 6, the *abutment* D is movable upon an axis so as to expose the rear of the bore for the insertion of the cartridge.

In Fig. 7, the *abutment* D is stationary, relatively to the stock, and the barrel slips away from the abutment to allow the insertion of the cartridge. The variations in the arrangement are very numerous, and the different devices form the subjects of numerous patents in the United States and foreign countries. See FIRE-ARM; BREECH-LOADING.

Ac'tion. (*Fire-arms.*) Used generally, in reference to the position or some characteristic of the firing mechanism; as *side action, snap action,* etc.

Specifically — the iron body which lies between the barrels and the stock.

Back action when the locks are bedded into the stock alone.

Bar action when the locks are bedded partly into the stock and partly into the action. Also called *fore* action.

Air'-gun. The air-gun is a pneumatic engine for firing bullets or other projectiles by force of compressed air. The child's popgun illustrates the principle of the air-gun: a pellet is forced through a tube or quill by a rammer from the larger to the smaller end, where it sticks fast, and another pellet is put in and pressed forward in the same manner, condensing the air between them, when the pressure on the first pellet overcomes its frictional adherence to the sides of the tube, the pellet is released, and is projected by the force of the expanding air. The ancients were acquainted with some kind of an apparatus by which air was made to act upon the shorter arm of a lever, while the longer arm impelled a projectile; and it is said that Ctesiphus of Alexandria, a celebrated mathematical philosopher, who lived B. C. 120, constructed an instrument in which the air, by its elastic force, discharged an arrow from a tube. (Montucla, "Histoire des Mathématiques," Vol. I. p. 267.) The first account of an air-gun is found in David Rivault's "Elémens d'Artillerie." He was preceptor to Louis XIII. of France, and ascribes the invention to a certain Marin of Lisieux, who presented one to Henry IV. of France, about A. D. 1600. An instrument of this kind was invented by Guter of Nuremberg about A. D. 1656. Various shapes have been adopted, from that of the ordinary musket to a gun resembling a common, stout walking-stick. It consists of a lock, stock, barrel, and ramrod; and is provided with proper cocks for filling it with compressed air by means of a force-pump. The lock is only a valve which lets into the barrel a portion of the air compressed in a chamber in the stock when the trigger is pulled. The gun is loaded with wadding and ball in the ordinary way, and when fired there is but little noise, and none of the other concomitants of gunpowder, smoke and odor. The usual range to which the air-gun propels a bullet is from sixty to eighty yards. In those guns having a sliding trigger, two or three bullets are successively and separately introduced, and may be expelled by one mass of condensed air. Air-guns have also been constructed upon the principle of revolving pistols, admitting the expulsion of several bullets after once charging with compressed air. Some varieties have an air-pump attached by means of which a more powerful compression of air may be produced. One air-gun in the form of a cane has two barrels, — one small one for the reception of bullets, and one large bore for the reservoir of compressed air. Elastic springs have also been used in connection with compressed air, but the

Fig. 102

Air-Gun.

latest improvements are those of Cornelius Borda. The reservoirs of the gun are filled with a mixture of oxygen and hydrogen in due proportion for producing water. The gun is provided with a small electric battery connecting with the trigger. The moment a portion of the gas is let out, an electric spark is produced, occasioning the instantaneous combustion of the mixture, and a high pressure in consequence of the excessive heat resulting from the chemical transformation. This gun is said to propel a bullet as far as an ordinary musket. The noiselessness of ordinary air-guns is accompanied by slight projectile force, and the gun of Borda in exploding a body of gases in confinement would probably cause as much sound as the combustion of gunpowder in quantity sufficient to generate the same projective force. SHAW's air-gun, patented in 1849, combines an endless band of vulcanized india-rubber with an air-exhausting apparatus; the electricity is so applied as to compress the air at a single stroke of the air-pump the moment before it is discharged. The steam-gun, exhibited in London a few years ago, exemplified a much more forcible agent than air for the propulsion of bullets.

In Fig. 102 the upper chamber is the reservoir of air, which is condensed therein by means of the piston and valve in the stock. The lower tube is the barrel, and the ball is rammed down to its lower end as usual. The gun being sighted, the motion of the trigger moves the valve, which admits a body of air to the rear of the ball and expels it from the barrel.

LINDNER, December 16, 1862. The lever conforms in shape to the stock of the gun, and is the

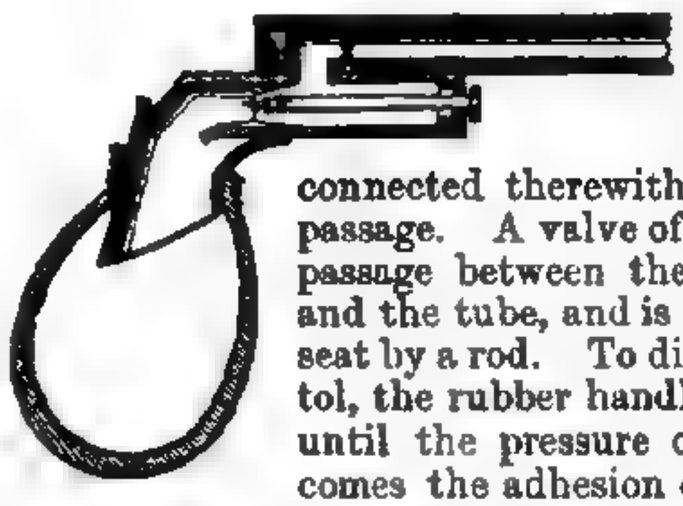
Fig. 103

Lindner's Air-Gun.

means of retracting the piston. The piston, when released by the trigger, is driven forward by the elastic force of the condensed spring, projecting the bullet from the barrel by further compression of the air. The spring is a helical ribbon, and condenses into a simple coil when the pressure of the lever is applied. The barrel is breech-loading, tilting on a pivot so as to expose the rear for the reception of the ball, and being locked shut by a catch. A projecting india-rubber ring at the joint of the barrel makes an air-tight joint when the barrel is closed. The projectiles have an expanding portion, which enters the rifle-grooves of the barrel to increase the accuracy of the flight.

GEDNEY, September 24, 1861. The hollow handle is formed of india-rubber or other flexible air-tight material, and communicates with a short tube placed beneath the barrel and connected therewith by means of a passage. A valve of cork closes the passage between the hollow handle and the tube, and is pressed into its seat by a rod. To discharge the pistol, the rubber handle is compressed until the pressure of the air overcomes the adhesion of the valve to its seat, when it is driven back; the air then escapes into the tube and thence into the barrel, driving out the projectile. This and the preceding are only toy-guns.

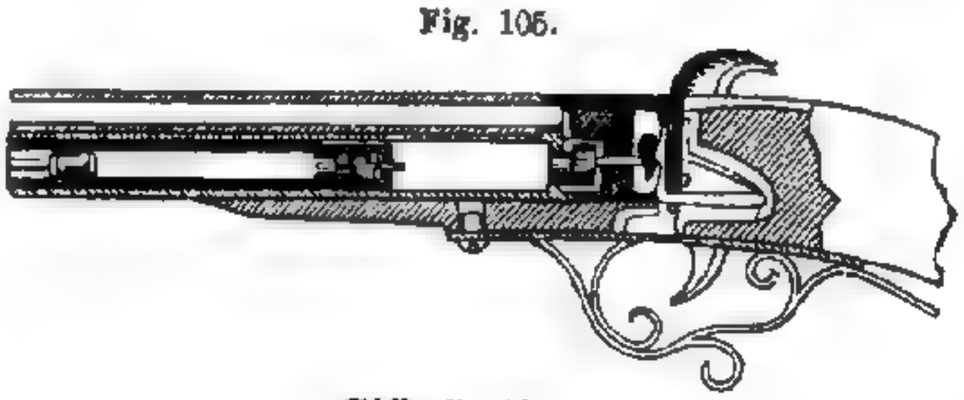
Fig. 104.



Gedney's Air-Pistol.

GIFFORD, February 9, 1864. The barrel is in communication with the inside of the trigger-box, in the interior of which is a valve-piston, consisting of a steel rod carrying a ring fitted with a caoutchouc disk for closing communication. Air enter the barrel by a bell-shaped chamber. By pressing strongly on the extremity of the rod, the disk is compressed and closes the reservoir orifice. By suddenly releasing the piston-valve the elasticity of the caoutchouc, combined with the pressure of the compressed air, causes the sudden opening of the reservoir orifice and emits a blast of air to the rear of the projectile. The air is compressed into a reservoir beneath the barrel, by means of a piston working

Fig. 105.



Gifford's Air-Gun.

longitudinally in a valved interior tube, and the valvular arrangements is to give an instantaneous emission of air and an immediate closure, so as not to waste the air by a protracted opening of the valve-way.

The South American Indians of the Amazon and Orinoco use a species of air-gun or blow-pipe for propelling poisoned arrows. It consists of a long, straight tube in which an arrow is placed and expelled by the breath. Near Pará, it is very ingeniously made of two stems of a palm, of different diameters, one fitted within the other to secure perfect straightness; a sight is fitted to it, near the

end. The arrows used are fifteen to eighteen inches long, having a little ball of down, from the silk cotton-tree, twisted round the smaller end so as to make it fit closely in the tube. In the hands of a practised Indian this is a very deadly weapon, and as it makes no noise he frequently empties his quiver before he gathers up his game.

Warburton, the eminent naturalist who wandered in these countries, gives a good account of their modes of hunting. See also Humboldt, and the Researches of Sir Robert H. Schomburgk in British Guiana.

A similar weapon is found among some of the Malay tribes, and is called by them the sumpitan.

Aristotle was acquainted with the fact that the air has weight, stating that a bladder inflated with air will weigh more than an empty one; as he was not acquainted with glass globes, which can be exhausted of air without losing their shape, we may infer that his statement with regard to the bladder was intended to apply to a hypothetical one which possessed the stiffness of glass, or else that the air was considerably compressed in the inflated bladder.

Hero of Alexandria, in his "Spiritalia," shows his knowledge of the elasticity of air, and how it could be used to produce many effects. He shows the air-pump.

Ctesibus developed the pump into an air-gun.

Air Pis'tol. A small weapon differing in no substantial respect but size and portability from the air gun.

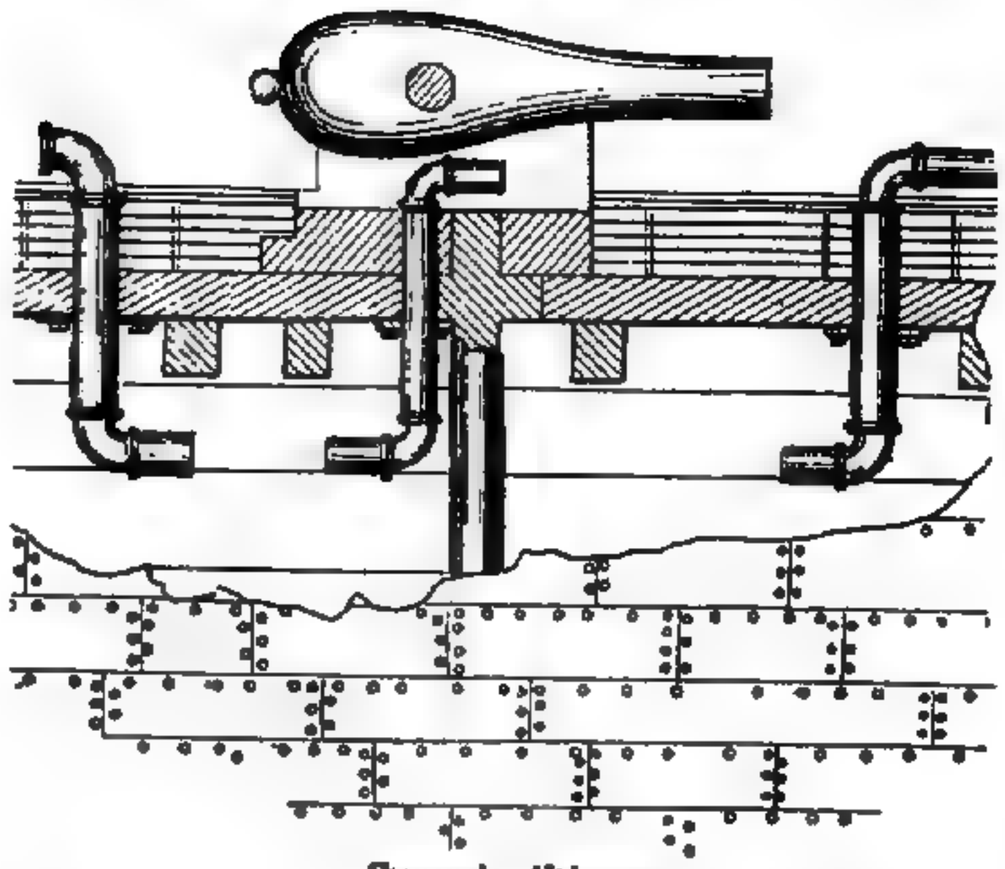
Al'ti-scope. CLARK, March 13, 1866. This invention consists of an arrangement of lenses and mirrors in a vertical telescopic tube, by means of which a person is able to overlook objects intervening between himself and the object he desires to see. When the sections of the tube are extended, the view is received upon an upper mirror placed at an angle of 45° and reflected thence down the tube to a lower mirror, where it is seen by the observer. The image is magnified by lenses intervening between the mirrors. The telescopic tubes are so connected that each in turn acts upon the next in series, as it comes to the end of its own range, and thus the desired elevation is arrived at. The means of extension is a winch and cords.

STEVENS, January 6, 1863. This affords a means for training guns to a given angle with the axis of the vessel, or on an object, while the gunner remains beneath the gun-deck. There is attached beneath the deck to the pintle of the pivoted gun a graduated index-plate, by which its horizontal bearing may be read. A telescopic tube, with two rectangular bends and with reflecting mirrors at the angles, is so placed as to be used from beneath the deck; two of these may be so situated as to form a base of sufficient length to obtain, by simultaneous observation, the distance by triangulation. Two screw-propellers, working in contrary directions, rotate the vessel so as to bring the guns to bear on the required point.

The upper and lower limbs of the telescopic tube are parallel; the one above deck is presented towards the object, the other to the eye. The image of the object, after being twice reflected, reaches the eye of the observer, whose person is not exposed.

A portable altiscope, adapted to enable a person to look over the heads of a crowd, is formed of a

Fig. 138.



Stevens's Altiscope.

hollow cane with perforations near its respective ends, opposite two reflectors arranged at angles of 45° in the cane. The cane being held vertically, and the upper orifice presented towards the object to be viewed, — a speaker, for instance, — the image is received upon one mirror and passes down the cane to the other, where it is observed by the person. Slides cover the openings when not used for observations, and the cane has then an ordinary appearance.

Am'mu-ni'tion. In its most comprehensive signification, this includes artillery and small-arm projectiles with their cartridges and the percussion-caps, friction-primers, etc., by means of which they are fired; also war-rockets and hand-grenades. For artillery, when the projectiles, their cartridges, primers, etc., are packed in the same box, it is designated in the United States service as *fixed ammunition*; this is the description furnished for field and rifled siege artillery. For larger calibers, the projectiles and cartridges are put up in separate boxes, round solid shot, however, being generally transported loose.

Up to 12-pounders for smooth-bore ordnance the cartridge is attached to the projectile; above that caliber the shell or case-shot are filled, the fuse inserted, and the sabot attached; in this case, the projectile is said to be *strapped*; shells of 8-inch caliber and upwards are seldom filled previous to issue, this operation being performed as they are required at the place where they are used. Projectiles for rifled artillery are always separate from their cartridges.

Fixed ammunition for field artillery is put up in boxes of uniform size for each caliber, each containing a given number of rounds, viz.: —

Smooth-bore 6-pounder gun . .	14
Smooth-bore 12-pounder gun . .	8
Smooth-bore 12-pounder howitzer .	12
Smooth-bore 24-pounder howitzer .	6
Smooth-bore 32-pounder howitzer .	4
Rifled-bore 3-inch or 10-pounder gun	10

Ammunition for small-arms is known in the United States service as *small-arm cartridges*. In these the bullet and cartridge are invariably put up together in boxes of 1,000, except some descriptions of

patented cartridges, which are put up in boxes containing 600 or 1,200, and repeating-cartridges, as Spencer's, in which the box is made to contain a multiple of the number which fills the breech-chamber.

Rules have been laid down for determining the proper supply of ammunition of each description for an army in the field.

That assumed by the British authorities allows 300 small-arm cartridges per man for six months' operations; of which an army of 60,000 men should have 2,680,000 with them, besides those in reserve.

This amount is understood to be in addition to that carried in the cartridge-boxes of the men, 60 rounds each in the case of an infantry soldier.

The wagons for this service are intended to carry 20,000 rounds each, and are drawn by four horses. Several wagons are organized into an equipment under the charge of a detachment of artillery: several such equipments would be attached to an army of 60,000 men, one for each division of infantry and a proper proportion for the cavalry; the remainder being in reserve.

The proportion given in the United States Ordnance Manual is 100 rounds for each man, 40 rounds in the cartridge-box, and the remainder in reserve for infantry.

Ammunition for cannon: 200 rounds for each piece, both of the reserves and active batteries; the ammunition which cannot be carried in the chests of the caissons to be kept with the reserves.

During our late civil war it is believed that, where at all practicable, the amount of readily accessible ammunition, both for artillery and small-arms, was kept largely in excess of the above standard.

A supply-train, under the charge of an ordnance-officer, was attached to each division, from which issues were made as required to the company or regimental officers, upon properly approved requisition.

The wagons of which these trains were composed were generally drawn by six horses or mules, and were capable of carrying from 40,000 to 60,000 rounds of small-arm cartridges, or an equal weight of artillery ammunition.

See WEAPONS; PROJECTILES.

Ar'ma-ment. A term expressing collectively all the cannon and small-arms, with their equipments, belonging to a ship or fortification; frequently applied, in a more restricted sense, to the artillery alone.

The armament of ships and forts has undergone a very great change within the past thirty years. About 1840 the 32-pounder gun was most usually employed both on shore and shipboard, 24-pounders forming no inconsiderable proportion of the armament of our forts. 8-inch and even 10-inch guns and howitzers were, however, mounted to some extent in the more important seaboard fortifications.

The armament of a line-of-battle ship mounting eighty-four guns consisted of twenty-two 32-pounders of 57 cwt. and ten 8-inch shell-guns of 63 cwt. on each of the two gun-decks, and twenty 32-pounders of lighter weight on the spar-deck; that of a 50-gun frigate was similar, omitting the battery of one gun-deck. In 1857 a 40-gun steam frigate was armed with twenty-four 9-inch guns on the main-deck and fourteen 8-inch and two 10-inch pivot-guns on the spar-deck; 11-inch pivot-guns were also introduced as a part of the armament of steam sloops and smaller [redacted].

Rifled or breech-loading ordnance was practically unknown. The commencement of our late civil war brought with it the era of 15-inch smooth-bores weighing 50,000 pounds, and at or shortly after its close 20-inch guns, weighing more than 100,000 lbs. and carrying a ball of 1,060 lbs., had been cast. The former of these classes now forms the usual armament of our monitors. Rifled guns of calibers up to 10 inches (as the Parrott 300-pounder) were also introduced, and this size has been exceeded in Europe, 30-ton Armstrong breech-loaders, carrying a projectile of 600 lbs. weight, being now in use in the English navy, while North Germany and other continental nations are little, if any, behind in this respect. In the United States service great reliance has been placed on the "smashing" qualities of round projectiles of large caliber fired from smooth-bore guns when employed against iron-clad vessels, while the impression of European artillerists is that they are comparatively inefficient in competition with elongated projectiles discharged from rifled guns; these are, accordingly, the only kind now employed abroad on first-class war vessels, and appear to have almost, if not entirely, superseded smooth-bores, with the exception of mortars in the armament of fortifications.

Ar'mo-rer's Gage. For verifying the dimensions of the various parts of small-arms are templets of various sizes and shapes, rings, and cylindrical or conical gages for interior dimensions. 200 are embraced in a complete set for the various arms made at the Government armory, of which about 78 are used for the rifle-musket alone.

Of these, the *caliber gage* measures the diameter of the bore.

The *dimension gages* show the length of the barrel and its diameter at various distances, the value in inches and parts being measured by the *caliper gage*.

Other gages measure the proper dimensions of the breech-screw and its thread, and those of the counter-bore of the barrel which receives it; others, again, the form, dimensions, and position of the sights.

A separate gage is required for the lock-plate, and for each separate part of which the lock is composed; as the *mainspring gage*, *sear gage*, *bridle gage*, *tumbler gage*, *hammer gage*, etc.; also gages for the various dimensions of the stock, of the bayonet, and of each of the appendages which accompany the gun.

The number of 200, above given, might be swelled to several thousand, by including those required for inspecting the various carbines and pistols made by different parties for the United States government; all which were made so that the parts of the same kind might be interchanged.

Ar'mor, Per'son-al. Defensive clothing or covering for the body in battle.

Scale and chain armor were common among the old Egyptians (time of Rameses III.) and Assyrians, also among the Persians and Romans. Dr. Abbott's collection in New York contains the iron helmet and scale armor of Sheshonk, or Shishak, the king of Egypt who overthrew Rehoboam, seven years after the death of Solomon. The scales are the shape of the Egyptian shield round end downward, and some of them are marked with the cartouche of the king.

The Sarmatians wore scale armor of pieces of horn

or horse-hoofs fastened to a linen doublet.

Goliath was armed with a coat of mail (1 Samuel xvii). It is frequently spoken of by Homer. Demetrius, son of Antigonus, had a coat of mail made of Cyprian adamant (perhaps steel). Cyprus was famous for its armor. The ancient Scythians had armor composed of horse's hoofs curiously strung and jointed together. Hengist the Saxon had scale armor A. D. 449, and King John of England possessed a hauberk of rings set edgewise, 1200. The cavalry of Henry III. had coats of mail. Henry VII. had a steel cuirass, 1500. Since the introduction of fire-arms the use of armor has been gradually discontinued, and it is now confined to the heavy cavalry or cuirassiers of European armies. As worn at present, it generally consists of a helmet of brass strengthened with steel, and a cuirass composed of a front piece, or breast-plate, and a back piece strongly laced or buckled together. The success of the French cuirassiers in the famous cavalry combat at Eckmuhl, 1809, was in a large degree owing to their wearing complete cuirasses, while the Austrians were only provided with breast-plates.

For illustrations and descriptions see Frost's Pictorial Histories, and the Iconographic Encyclopædia.

Of ancient armor some remarkable examples are to be found in the tribolites of the Silurian age, "a family in whose nicely jointed shells the armorer of the Middle Ages might have found almost all the contrivances of his craft anticipated, with not a few, besides, which he had failed to discover. They were covered over, back and head, with the most exquisitely constructed plate-armor; but as their abdomens seem to have been soft and defenceless, they had the ability of coiling themselves round on the approach of danger, plate moving on plate with the nicest adjustment, till the rim of the armed tail rested on that of the armed head, and the creature presented the appearance of a ball defended at every point. In some genera, as in Calymene, the tail consisted of jointed segments till its termination; in others, as in Illænus, there was a great caudal shield, that in size and form corresponded to the shield which covered the head; the segments of Calymene, from the flexibility of their joints, fitted close to the cerebral rim; while the same effect was produced in the inflexible shields, caudal and cephalic, of Illænus, by their exact correspondence, and the flexibility of the connecting rings, which enabled them to fit together like two equal-sized cymbals brought into contact at every point by the hand." — HUGH MILLER.

Arms. The club was the first offensive weapon. By knots and points it became a mace; an edge and a pole converted it to a battle-axe. It was adapted for thrusting by giving it a point, and became a pike or spear; and when adapted to be thrown became a dart or javelin, which might be recovered by a line, as among the Moors. Shortened and pointed, it became a dagger or poniard, and by receiving an edge became a sword, scimeter, or similar weapon. Pointed, and associated with a motor to propel it, we see the arrow and its bow, which is, critically considered, a really beautiful invention. See ARCHERY.

"The first weapons of mankind were the hands, nails, and teeth; also stones and branches of trees, the fragments of the woods; then flame and fire were used, as soon as they were known; and lastly was discovered the strength of iron and brass. But the use of brass was known earlier than that of iron, inasmuch as its substance is more easy to work, and its abundance greater."—LUCRETIUS; d. 51 B. C. *æt.* 44.

History commences after the invention of the bow and arrow, and the Australian race seems to have diverged from the parent stock before its introduction, as they, and they only, do not possess it. They have a curious analogue, however, in their flexible spears, which are bent, when adjusted for throwing, so that their reaction in straightening may increase the force of the projection. The peculiar course of their flight when they did not straighten perfectly may have suggested to them the very unique weapon, the boomerang, which was imported into England as a curiosity perhaps 30 years ago.

During the historic period we find the most ancient weapon noted in the Bible is the sword. It was the "instrument of violence," as Jacob called it, wherewith Simeon and Levi slaughtered the Shechemites (Genesis xxxiv. 25).

Phinehas, the grandson of Aaron, carried a javelin. Ehud had a short dagger (Judges iii. 16). David declined Saul's sword, and used a sling, but afterward took the sword of Goliath. Many centuries before, all these weapons had been used in China, India, Assyria, and Egypt.

Pliny ascribes the invention of the sling to the Phœnicians. The Balearic Islanders were celebrated for their expertness in its use.

Slings and bows were employed by all the nations of antiquity, but among those who attained the highest military reputation, as the Greeks and Romans, were looked upon merely as auxiliary weapons, and the soldiers who used them were considered as an inferior class. The heavy-armed soldiers, who composed the strength of their armies, were armed with the spear and sword. The former, as used by the Greeks, was some 16 or even 18 feet in length, and enabled them to form a line of battle 16 men deep, — a solid mass capable of withstanding the most violent shocks, or of breaking the firmest ranks of any enemy who was not armed and disciplined like themselves; it was, however, deficient in mobility and activity. The Romans, on the contrary, preferred an order of formation and weapons which admitted of greater activity and allowed more scope to the efforts of the individual soldier. Besides a lighter spear, their principal weapon was the *pilum*, a short and massive javelin with a triangular iron head, which was darted by hand when within a few paces of their opponents, after which they drew their swords and advanced for close conflict. The Roman foot-soldier's sword was a short, two-edged weapon, greatly resembling the foot-artillery sword formerly used in the United States Army, and was adapted for either cutting or thrusting, though the soldier was instructed to prefer the latter as more effective and permitting him to preserve a better guard of his own person.

The formation of the legion was in eight ranks, and a distance of three feet was preserved between each file, as well as each rank, thus allowing ample room for the maximum effort of each separate man.

The offensive arms of the cavalry were a javelin

and a long broadsword.

Cavalry does not seem to have performed such an important part among the Greeks and Romans as it did among the more Eastern nations, as the Parthians, whose mounted archers, on more than one occasion, defeated and almost annihilated the legions of Rome.

No important change in arms, except the introduction of the cross-bow, seems to have been made until the introduction of gunpowder; though the character of the forces employed underwent a complete revolution. As Europe settled down into the gloom of the Middle Ages, disciplined armies became unknown, and the barbarous nations of the North who had overrun it, in the course of time becoming converted into peaceful tillers of the soil, had lost their former military habits, and in times of war degenerated into little better than camp followers.

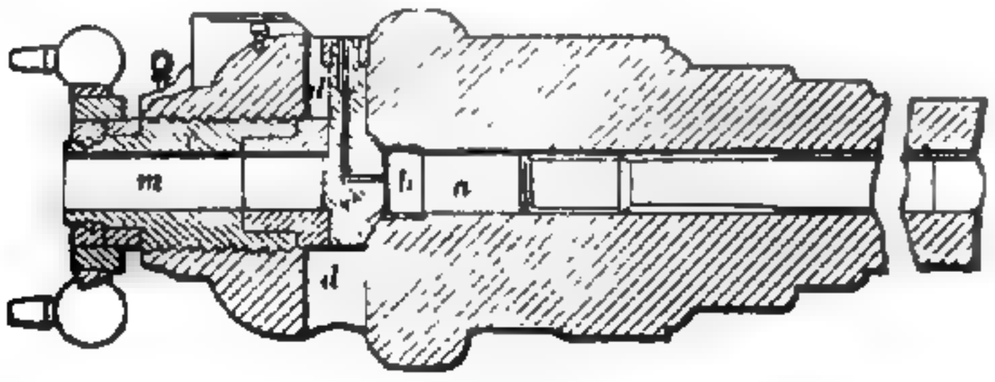
Cavalry, including the knights and men-at-arms by whom they were attended, constituted almost the entire strength of an army, and being nearly invulnerable to the ordinary weapons used by the footmen of that day, such as pikes and bills, were capable of putting to flight or slaughtering with impunity many times their own number of the latter, who were in general destitute of armor of any kind. The introduction of fire-arms has gradually effected an entire change in the composition and discipline of modern armies, and though the lance and sword or saber are still employed, they are used merely as auxiliaries. See ARTILLERY, FIRE-ARMS, PROJECTILES, etc. For a list of arms of various kinds, cutting, missile, etc., see WEAPONS.

"Ships' arms are cannons, carronade, mortars, howitzers, muskets, pistols, tomahawks, cutlasses, bayonets, and boarding-pikes." — ADMIRAL SMYTH.

Arm'strong Gun. A description of ordnance adopted in the English artillery for all field-guns and many of larger caliber.

It is built up of different parts, so disposed as to bring the metal into the most favorable position for the strain to which it is to be exposed. See CANNON.

Fig. 862.



Armstrong Gun.

The illustration does not show the mode of *building up* the gun, but illustrates the mode of breech-loading. The inner portion of the barrel is made of coiled iron or steel, welded; that mode of constructing being adopted to avail the tensile strength of the metal in resisting the bursting force of the discharge. The mode of reïnforcing differs somewhat in the different calibers and styles of the arm, but consists, generally speaking, of a number of reinforce bands of superior strength and thickness, over and in the vicinity of the charge-chamber and the parts weakened by the transverse cavity in which the breech-block is slipped.

a is the charge-chamber.

b the gas-check.

c is the breech-block which slides in a transverse slot *d*. The breech-block is traversed by the vent.

e is a breech-screw having an axial aperture *m*, through which the charge is introduced from the rear, when the breech-block *c* is withdrawn. After the charge is inserted in the chamber *a*, the block *c* is replaced, and the breech-screw *e* is screwed up, forcing a projection on the anterior face of the breech-block into the conical seat at the rear of the bore, and tightening the gas-check *b* in its seat, to prevent any escape of gas rearwardly.

Ar'que-buse. This piece, an early attempt at a portable fire-arm, had a massive stock laid to the

Fig. 386.

Arquebuse.

shoulder, and an offset near the muzzle by which it might be rested against an object, to break the recoil. It was fired by a match. It was used in the battle of Morat, where the Swiss defeated Charles the Bold, 1476.

Ar'row. The missile which is projected by a bow. Bundles of arrows were called *sheaves*.

It is usually of reed or of wood, and tipped with the best accessible materials; such as bone, flint, obsidian, metal.

The old English rule was to have the arrow half the length of the bow, and the latter the length of the archer, so that a *cloth-yard shaft* was used by a man six feet high.

The *bolt* was a peculiar arrow adapted to be shot from a cross-bow. The arrow of an arbalest was termed a *quarrel*.

Immense quantities of flint arrow-heads are found in the Celtic barrows throughout Europe. The arrow-heads of the Scythians and Greeks were of bronze, and had three flanges like a bayonet; such have been found at Persepolis and Marathon. The "barbarians," say the classic writers, use barbed (*aduncæ, hamatæ*) and poisoned (*venenatæ*) arrows. The poison on the arrow was called *toxicum*, from its relation to the bow, and the word was extended to poison in general.

The shaft was of polished wood, cane, or reed. The latter actually gave names to the weapon, — *arundo, calamus*. The Egyptians used reed shafts; their arrows were from 22 to 34 inches in length, and are yet extant.

The monuments show feathered shafts.

In the time of Homer, arrows were sometimes poisoned. The poisoned arrows of the Indians of Guiana are blown through a tube. They are made of the hard wood of the *Cokarito* tree, are about the size of a knitting-needle nine inches long, and mounted on a

yellow reed four or five feet long. One end is sharpened, and poisoned with *woorai;* the rear end receives a pledget of cotton to act as a piston in the tube. The effective range is about forty yards. The hardwood spike can be removed at pleasure; twelve or fifteen such spikes are carried by the hunter in a little box, made of bamboo. The poisoned spike is cut half through, at about a quarter of an inch above the point where it fits into the socket of the arrow; and thus, when it has entered the animal, the weight of the shaft causes it to break off, the shaft falls to the ground uninjured, and is fitted with another poisoned spike and used again.

In like manner the arrows of the Bushmen, Africa, often have the shafts partly cut through, so that they may break and leave the point in the wound.

The serrated weapon of the sting ray is used by the Malays for heading some of these blow-arrows, with the express intention that they might break off in the wound.

The arrow-heads of the Shoshones of North America, said to be poisoned, are tied on purposely with gut in such a manner as to remain when the shaft is withdrawn.

A similar idea is carried out in a Venetian dagger of glass with a three-edged blade, having a tube in the center to receive poison. By a certain wrench the blade was broken off, and remained in the wound.

"In passing overland from the Essequibo to the Demerara," says Waterton, "we fell in with a herd of wild hogs. An Indian let fly a poisoned arrow at one of them; it entered the cheek-bone and broke off. The hog was found dead about 170 paces from the place where he had been shot. He afforded us an excellent and wholesome supper." The wild tribes of the Malayan peninsula, who use poisoned arrows, eat the meat of animals killed by these deadly weapons, without even troubling themselves to cut out the wounded part.

There is reason for supposing that the discovery of the various poisons used for weapons, and the practice of applying them to such a purpose, arose spontaneously and separately in the various quarters of the globe. Poisoned weapons are used by the Negroes, Bushmen, and Hottentots of Africa; in the Indian Archipelago, New Hebrides, and New Caledonia. They are employed in Bootan, Assam, by the Stiens of Cambodia, and formerly by the Moors of Mogadore. The Parthians and Scythians used them in ancient times.

The composition of the poison varies in different races; the Bushmen, Hottentots, and others, using the venomous secretions of serpents and caterpillars. In the Bosjesman country, Southern Africa, the natives hunt the puff-adders, in order to extract the poison. They creep upon the reptile unawares, and break its back at a single blow. The poison-glands are then extracted; the venom is very thick, like glycerine, and has a faint acid taste. This is mixed, on a flat stone, with an acrid poisonous gum, called "parki"; after being worked until it becomes of the consistency of thick glue, it is spread over the barbed head of the arrow and for about two inches up its point. The arrows are then dried in the sun. Each warrior carries some half-dozen of these devilish weapons, a wound from one of which is as deadly as the bite of the adder itself.

In Ceylon the cobra-tel poison is extracted from certain venomous snakes, such as the Cobra de Capello (from which the poison takes its name), the Carawella, and the Tic polonga; arsenic and other drugs are added, and the whole is "boiled in a human skull." Three Kabra-goyas (*Hydrosaurus salvator*) are tied near three sides of the fire, with their heads toward it; they are tormented with whips to make them hiss, so that the fire may blaze! The froth from their lips is added to the boiling mixture, and as soon as an oily scum rises to the surface, the "cobra-tel" is complete. Probably the arsenic is the most active ingredient in this poison.

The Ceris are said to prepare poison for their arrows in the following manner: "They first kill a cow, and take from it its liver; they then collect rattlesnakes, scorpions, centipedes, and tarantulas, which they confine in a hole with the liver. The next process is, to beat them with sticks, in order to enrage them; and, being thus infuriated, they fasten their fangs and exhaust their venom upon each other and upon the liver. When the whole mass is in a state of corruption, the women take their arrows and pass their points through it; these are then allowed to dry in the shade."

The Indians of Choco and Barbacoas use the "Veneno-derana," or frog poison, which is obtained by placing a species of yellow frog, that frequents the swamps, over hot ashes, and scraping off the viscid humor that arises. After thus torturing the frogs, they are allowed to escape, in order that they may serve another time. "Veneno-de-culebra," or snake poison, is also said to be used in Choco.

Ar'se-nic. A soft, brittle, and poisonous metal of a steel-gray color. Equivalent, 75; symbol, As.; specific gravity, 5.7. It volatilizes, exhaling an odor of garlic; fuses at 400° Fah., and is easily inflamed. It combines with oxygen in two proportions, forming arsenious and arsenic acids. The former salt is As. 75, O. 24; the latter, As. 75, O. 40. The former is the common white arsenic of commerce, very poisonous, and a dull white powder, sp. gr. 3.07.

It is used to alloy lead for shot-making, causing the metal to pour more readily, and hardening the shot.

Ar-til'ler-y. The word seems to have a very extended signification, having been originally applied to military engines of every description capable of throwing heavy missiles, as the ballista, catapult, etc. Uzziah made use of them at Jerusalem 810 B. C. They are described (2 Chronicles xxvi. 15) as "invented by cunning men, to be on the towers and upon the bulwarks, to shoot arrows and great stones withal." The Chinese claim to have used cannon 618 B. C., and engines for throwing heavy stones were used in Sicily 300 B. C. Each Roman Legion under the early emperors was furnished with an artillery train, consisting of 10 larger and 55 smaller engines for throwing stones and darts, which accompanied it on its marches. These engines appear to have corresponded to the siege artillery of modern times, and were merely employed in the attack and defence of fortified places. Their want

of portability probably prevented them from being of much service in pitched battles on the open field. The date of the introduction of fire-arms as artillery appears involved in great obscurity. The artillery of the Moors is said to date back to 1118; from the few faint and imperfect allusions which occur here and there in old writers, it seems probable that their invention bore some analogy to rockets, or the projectile was self-propelling.

The following are some of the dates ascribed to the introduction of some military engines and artillery:—

Catapult invented by Dionysius of Syracuse,	B. C. 399
Gunpowder artillery used in China	A.D. 85
Cannon throwing stones, weighing 12 pounds, 300 paces	757
The Moors use artillery in attacking Saragossa	1118
The Moors use engines throwing stones and darts by means of fire	1157
The Chinese employ cannon throwing round-stone shot against the Mongols	1232
Cordova attacked by artillery	1280
A mortar for destroying buildings, etc. described by Al Mailla, an Arab historian	1291
Gibraltar taken by means of artillery	1308
A cannon in the arsenal at Bamberg	1323
Balls of iron thrown by means of fire used by the Moors	1331
Ten cannon prepared for the siege of Cambray	1339
The Moors defend Algesiras against Alphonso XI. by means of mortars	1343
Four pieces said to have been used by Edward III. at Crecy	1346
An iron gun with a square bore, for carrying a cubical shot of 11 pounds' weight, made at Bruges	1346
Artillery used by the Venetians at the siege of Chioggia	1366
Artillery used by the Turks at the siege of Constantinople	1394
Red-hot balls fired by the English at the siege of Cherbourg	1418
The great cannon of Mahomet II. employed against Constantinople	1453
Louis XI. of France has twelve cannon cast to throw metallic shot, for use as a siege train.	1477
Brass cannon first cast in England	1521
Iron " " " " "	1547
Howitzers introduced	1697
Maritz of Geneva introduces the method of casting guns solid and boring them out	1749
Carronades invented by General Melville	1779

For continuation of the subject and details, see ORDNANCE; MORTARS; PROJECTILES; WEAPONS, etc.

In European services, artillery is divided into

Field Artillery	Horse Artillery
Foot "	Marine "
Garrison "	Siege "
Heavy "	Standing "

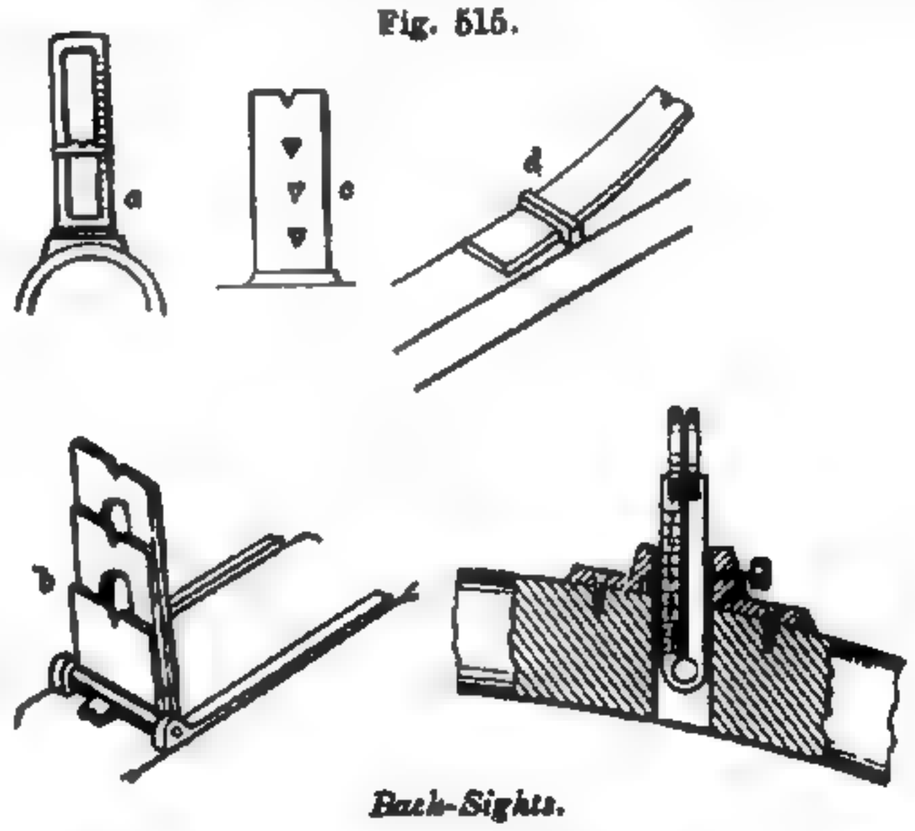
Ar-till'er-y Lev'el. An instrument adapted to stand on a piece of ordnance, and indicate by a pendulous pointer the angle which the axis of the piece bears to the horizontal plane. By its means any required angle of elevation is given to the piece.

Az'o-tine. An explosive: Saltpeter, 69.05; carbon, 15.23; sulphur, 11.43; petroleum, 4.29 per cent.

— B —

Back-sight. 1. (*Fire-arms.*) The rear sight of a gun. It may be of various forms. In the old-fashioned arms intended for round balls, it was merely a notch in a knob or plate near the breech of the gun, the proper elevation to be given being estimated by the marksman. As the effective range scarcely exceeded 250 to 300 yards, this could be done with sufficient accuracy by an expert marksman; but with the introduction of the elongated bullet, giving ranges of 1,000 yards and upward, it became necessary to seek some more efficient means of securing the proper range at these long distances, so that the bullet might not either pass over or fall short of the object. For this purpose was introduced

Fig. 515.



Back-Sights.

the rear-sight (*a*, Fig. 515), consisting of an upright slotted branch, which was jointed to a seat on the barrel of the gun, or, in some instances, on the small of the stock in rear of the barrel. A notched slider on the upright branch could be elevated as desired, and by elevating the muzzle of the gun until this notch and the front-sight were in line, any range within the limit of projection of the piece could be attained.

This sliding sight has, in the United States service, been superseded by the leaf-sight (*b*, Fig. 515), which is more compact and less liable to derangement. Also called *Folding-Sight.*

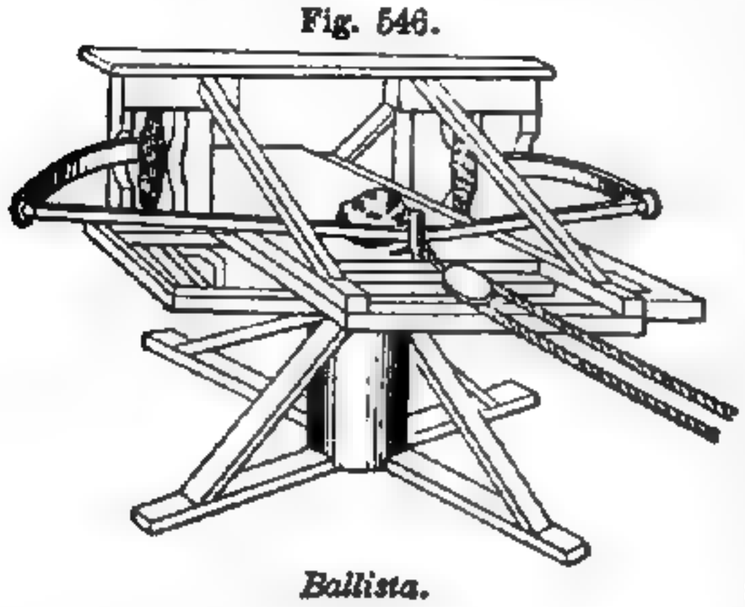
Other back-sights, especially those first introduced in Southern Germany, have been made very different in form from those described; one variety (*c*, Fig. 515) being permanently fixed perpendicularly to the barrel, and having notched holes at proper hights through which to sight, and another (*d*, Fig. 515) being segmental in shape, and moving circularly in a direction longitudinal to the barrel through a stud fixed thereon.

Another form of back-sight (*c*, Fig. 515) vertically adjustable for range, and attached to the stock, has

a graduated spring-piece slipping within a vertical slot in the small of the stock, and is adjusted as required. Its spring retains it in place, or it may be clamped by a set-screw or lowered below the line of the hind-sight on the barrel.

Bal-lis'ta. (*Weapon.*) A machine used anciently for throwing darts or stones.

Fig. 546.



Ballista.

The name is applied to two different machines.

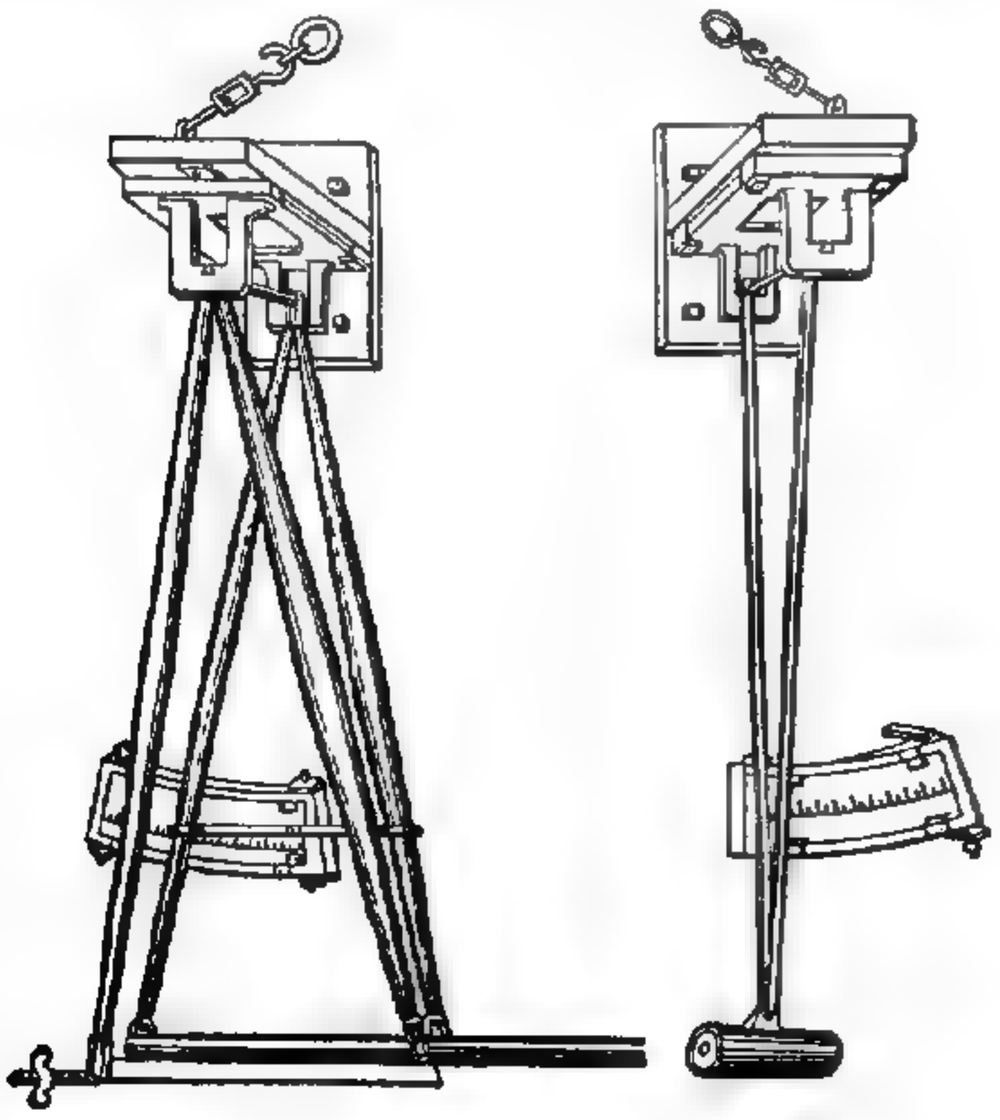
One resembles the catapult in the mode of obtaining the power, and the other is a cross-bow on a large scale, with a tackle to draw the bowstring.

a. The more ancient ballista had a vibrating arm, which was drawn back against the tension of cords made of human hair, horse-hair, or catgut. When drawn back to its full scope, it was suddenly released, and its head came with a violent blow against the ends of the darts arranged on a table above and pointed towards the enemy.

b. The other ballista was a cross-bow, arranged upon a standing frame (Fig. 546). The string was retracted by a tackle, and was cast loose by some device, projecting a dart or a stone, as the case might be. The dart or stone lay upon a table, and was adjusted against the string before casting off.

Bal-lis'tic Pen'du-lum. This instrument is designed to determine the velocity of projectiles of

Fig. 547.



Ballistic Pendulum.

cannon and small-arms. It was invented by Robbins about 1760, and described by him in his tract on Gunnery. It has been improved by Hutton and Gregory, in England; Piobert and Morin, in France; and Mordecai, in the United States.

The original instrument consisted of an iron bar suspended by a transverse axis, and having a block of wood strengthened with iron plates to receive the impact of the ball. On being struck, the block swung like a pendulum, and pulled a ribbon through an orifice in the fixed framework. The length of the ribbon withdrawn is considered equal to the chord of the arc of vibration.

The use of the pendulum depends upon the dynamical fact that if a body of small mass impinge with great velocity upon a much larger body at rest, and the two bodies after impact move on together with a velocity which can be easily measured, the masses of the two bodies being given the whole momentum after impact is known; and as this is the momentum of the smaller body before impact, the velocity with which it struck the larger body can be determined.

As now used, the block consists of a cast-iron case or mortar, partially filled with bags of sand or a block of lead. It is suspended by wrought-iron bars from an axis working on knife-edges in V-grooves, and the arc of vibration is measured on a copper arc by an index carrying a vernier.

The arc of vibration being ascertained, the following points must be known, in order to calculate the velocity of the ball on striking:—

1. The respective weights of the ball and pendulum.
2. The distance of the centers of oscillation or percussion from the axis of suspension.
3. The distance of the center of gravity from the axis of suspension.
4. The angular velocity of the pendulum after impact.

The upper figure represents the pendulum for small-arms; the lower one for ordnance.

The gun itself has been swung on a pendulum, and its arc of recoil measured to furnish datum for estimating the force of the discharge.

It is also used to determine the quality of powder. See also EPROUVETTE.

The *Chronoscope* and *Electro-Ballistic* apparatus afford more perfect means of determining the point sought. See CHRONOSCOPE: ELECTRO BALLISTA.

Ball-screw. An implement for extracting bullets from the barrel of a gun in cases where it would be dangerous or impossible to expel them by firing. It is screwed on to the end of the ramrod, which, being turned, causes the screw-threaded pointed end of the ball-screw to enter the bullet, which is then withdrawn by pulling the ramrod. The common form is shown at *a*, Fig. 549.

Fig. 549.

Ball-Screws.

WITZLEBEN'S ball-screw, *b*, has two jaws with sharp-edged interior shoulders, constituting a portion of a concave screw-thread, which enters the bullet to prevent it from slipping from the grasp of the jaws.

Bal-loon' Mus'ket. One for perforating balloons of observation. As specially made by Krupp for the German army it was designed to pick off the postal balloons from Paris during the siege of that city. It was a heavy rifle swiveled on a standard upon an artillery wagon. — "*La Nature.*" Its range enabled it at times to pick off balloons at 3,200 feet elevation.

Bal-loon' Tor-pe'do. A torpedo elevated and floated over an enemy by a balloon, and dropped by time arrangement (fuse or clockwork), or by means of electric connection through wire reaching from the point of dispatch.

Fig. 204

Bar and Open Bead Sight.

Bar and Open Bead Sight. (*Rifle.*) A form of sight in which the *aperture* is supported on a segment plate in the ring. Fig. 204.

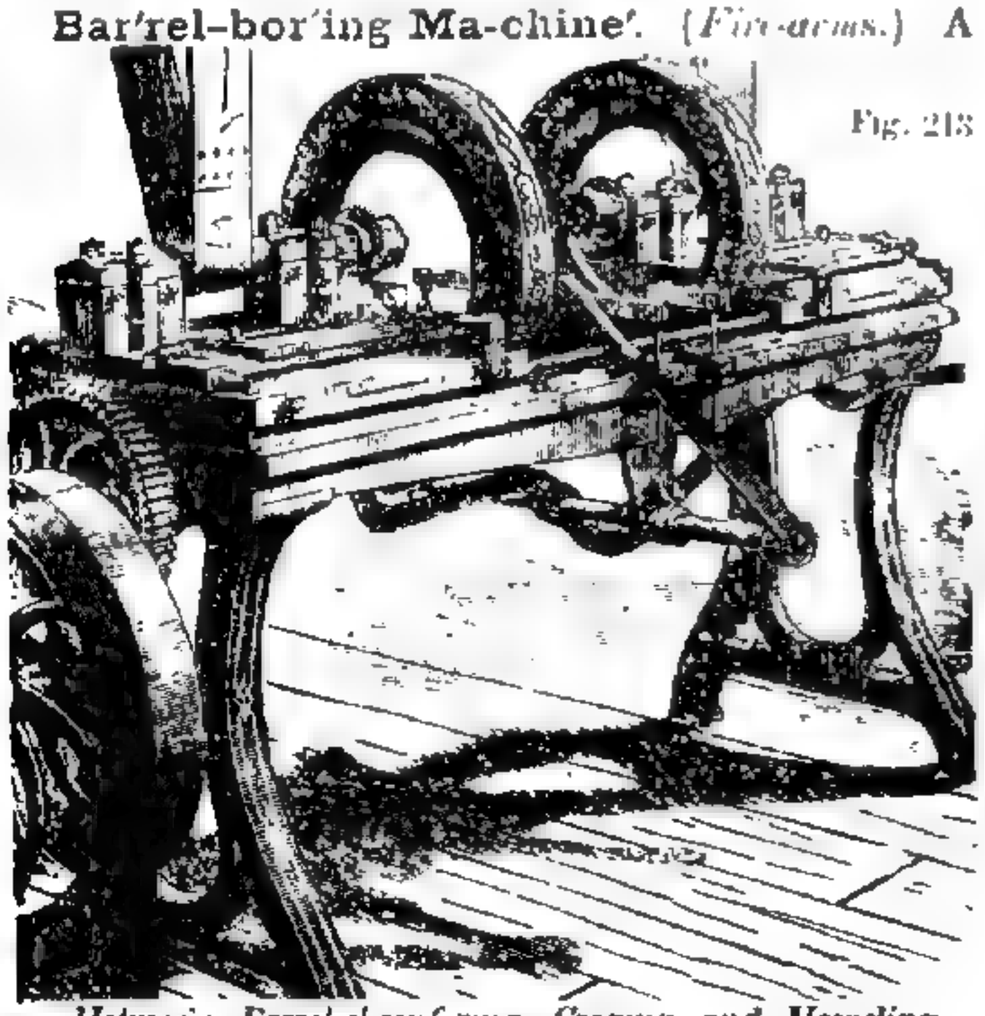
Fig. 205.

Bar and Slit Sight.

Bar and Slit Sight. (*Rifle.*) A form of sight having a plate with a vertical slit. Also called a *slit-bar sight*. See Fig. 205.

Bar'rel-bor'ing Ma-chine'. (*Fire-arms.*) A lathe specially adapted to boring out gun-barrels. See RIFLING MACHINE.

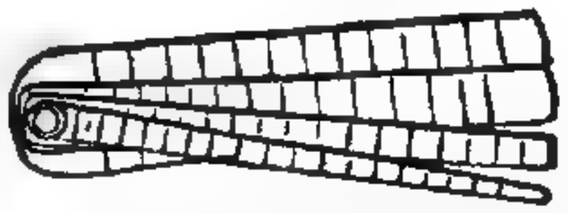
Fig. 213



Holmes's Barrel-chamfering, Crozing, and Howeling Machine.

Bar'rel Gage. A gage for testing the diameter of gun-barrels according to a standard; the instrument has several tapered slips, each graduated, and having a certain range of sizes, the diameter of the barrel being determined by slipping the gage into the muzzle.

Fig. 216.



Gun-barrel Gage.

Bat'ter-y-gun. A gun having a capacity for firing a number of shots consecutively or simultaneously, without stopping to reload. There are a number of varieties.

1. A piece of ordnance having a number of load-chambers attached to a vertical axis, and consecutively presented at the rear of a cannon-bore. As each takes its place at the breech, it is advanced into the bore and locked before firing. (HARDY, 1862; DODGE, 1856.)

2. A chambered breech-piece, revolving in a vertical plane, and presenting its chambers consecutively at the open rear of the barrel, which is common to all the chambers. The principle of construction is that of the revolving chambered pistol. (HEDRICK, 1870.) See also FIRE-ARMS, where PUCKLE'S Revolving Battery Gun, English Patent, 1718, is described and figured.

3. A number of parallel barrels arranged in rank, and having connected vents for intercommunication of fire. (TOWNSEND, 1871.) The infernal machine of Fieschi, which he fired on Louis Philippe, was a row of barrels clinched to a frame, and had a train of powder which was laid over all the vents in succession, like the row of barrels in a proving-house.

The Requa battery consists of 25 rifles, each 24 inches long, mounted in a horizontal plane upon a field-carriage. It is breech-loading, the cartridges being forced into the chambers by a sliding bar worked by two levers. By a lever beneath the frame the barrels may be diverged, so as to scatter the balls 120 yards in a distance of 1,000 yards.

The weight of the battery-gun used at Charleston, S. C., was 1,382 pounds. Served by three men, it fired 7 volleys, or 175 shots, per minute. Its effective range was 1,300 yards.

4. Forms of many-barreled cannon, revolving on a vertical axis, the pieces being muzzle-loaded. (MILBURN, 1866. Divergent, NATCHER, 1864.)

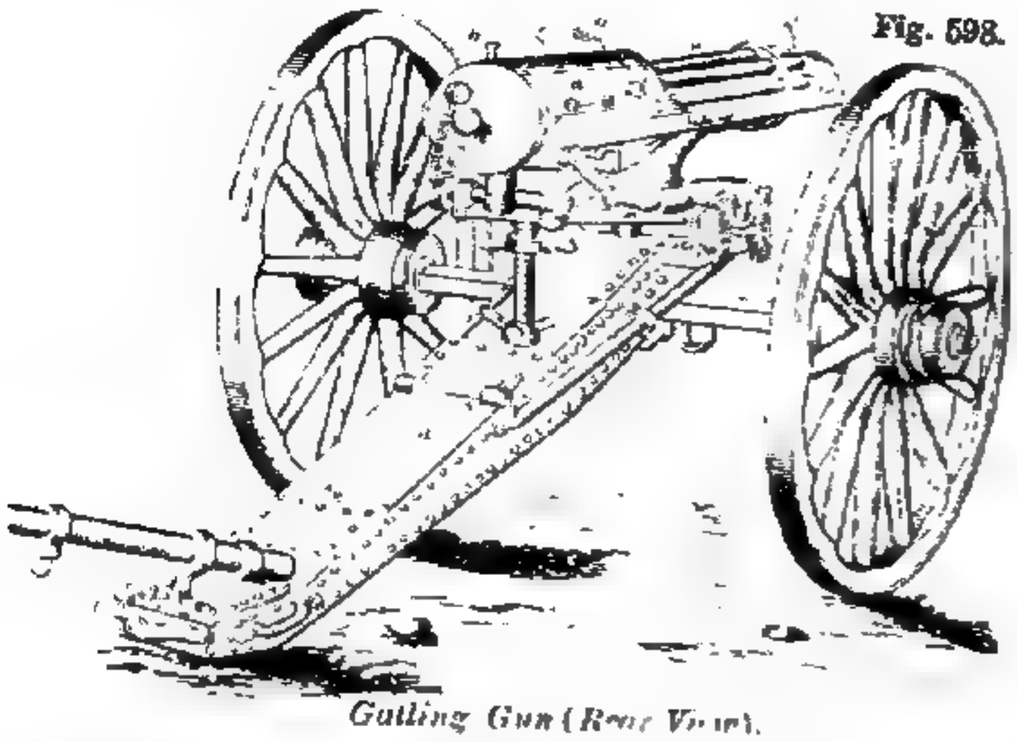
5. A cluster of rotating barrels, consecutively loaded and fired by automatic action. (GATLING, 1861–65.) This will have a longer description presently.

6. A cluster of barrels, in whose rear is placed a chambered plate, each of whose chambers corresponds to one of the cluster of barrels, against whose rear it is locked before firing. The MITRAILLEUR (which see).

7. A number of chambered blocks brought consecutively to the positions for loading, and then for firing, through a group of barrels equal in number to the number of chambers. (TAYLOR, 1871.)

The Gatling gun has a revolving cluster of parallel barrels. In the rear of each barrel, and rotating

Fig. 598.



Gatling Gun (Rear View).

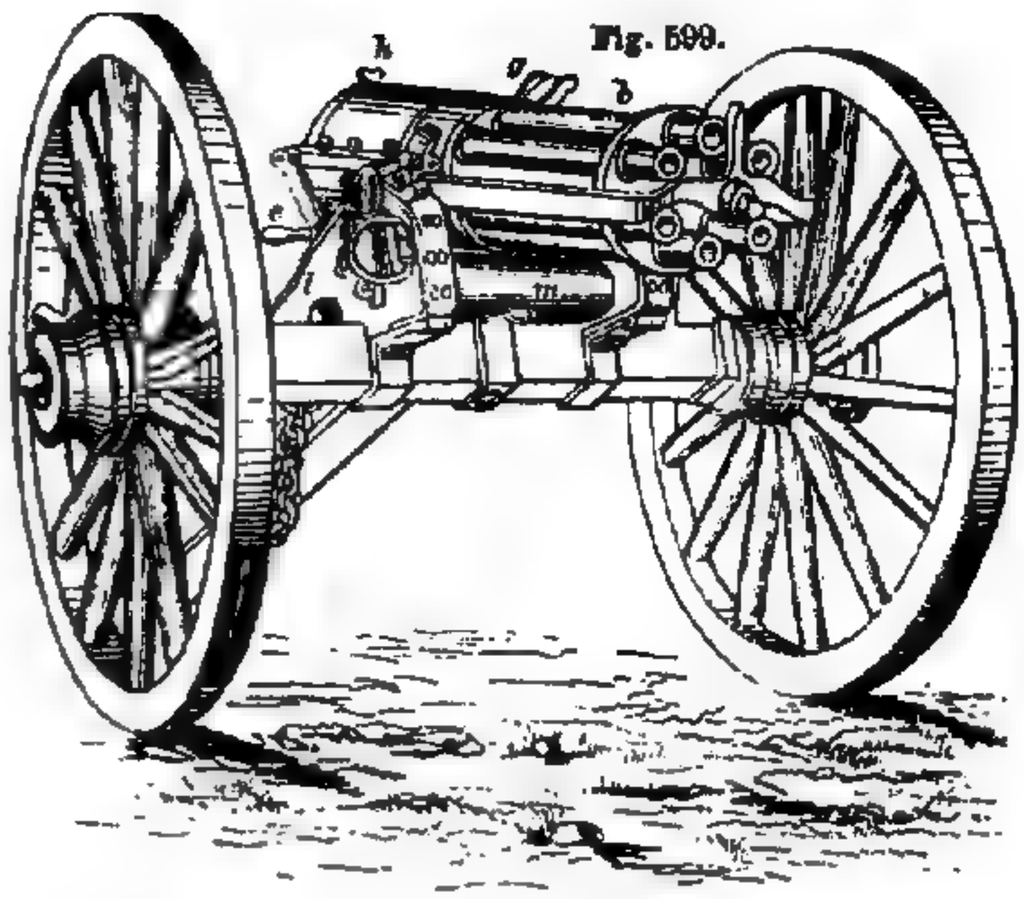
therewith, is its own loading, firing, and spent-cartridge-shell-retracting mechanism. All these parts are rigidly secured upon an axial shaft, which is revolved by means of bevel gearing and a crank, as shown in Fig. 598, and also in Fig. 599, which are respectively rear and front views of the gun mounted. In the rear of the cluster of barrels *b* is a stationary cylinder *a*, within which are the loading plungers, the firing-pin, and the cartridge-retractor.

Each of these parts moves horizontally and in line with the barrel to which it appertains, the motion being attained by the pressure of lugs on the moving mechanism against stationary cam-rings in the cylinder as the cluster of parts revolves. The ammunition is fed in at the hopper *g*; or, as in an improved form shown in the full-page engraving opposite to page 250, the ammunition is contained in a feed-drum which is placed above the hopper, and delivers its cartridges one at a time from its successive rows. Its capacity is four hundred cartridges, and these may all be fired in one minute.

As the cluster of barrels revolves, the operative mechanism in the rear of each barrel comes under the influence of the cam-rings in the interior of the cylinder. The loading-rod of a given barrel being in the most retracted position when that barrel is uppermost, a cartridge drops into the groove in front of the said rod; as the barrels rotate, this rod is pushed forward, and drives the cartridge into the rear of the barrel; a firing-pin, which traverses in a longitudinal slot in the loader-rod, is all this while being retracted, until the barrel is at its lowest position; then the firing-pin passes the retracting cam, and is abandoned to the influence of a spring, which drives the end of the pin forcibly against the cartridge and explodes the fulminate. Now comes into play a hook whose shank runs parallel with the loader-rod, and withdraws the empty shell of the cartridge, which drops out of the machine. The barrel then takes its turn again above, and so the work proceeds.

e is the working-crank, *c* the elevating-screw, *d* the trail, *k* the loop by which the trail is attached to the limber, *h i* are the back and front sights, *l* the cheeks of the carriage. In the view on the opposite page the Gatling gun is represented as adapted to various services: mounted on tripod, on carriage, on horse, on camel. The weight of the guns is 125, 300, 500, 600 pounds, according to size. The firing is always one shot at a time, and a number of shots equal to the number of barrels at each revolution of the crank. The recoil is practically nothing.

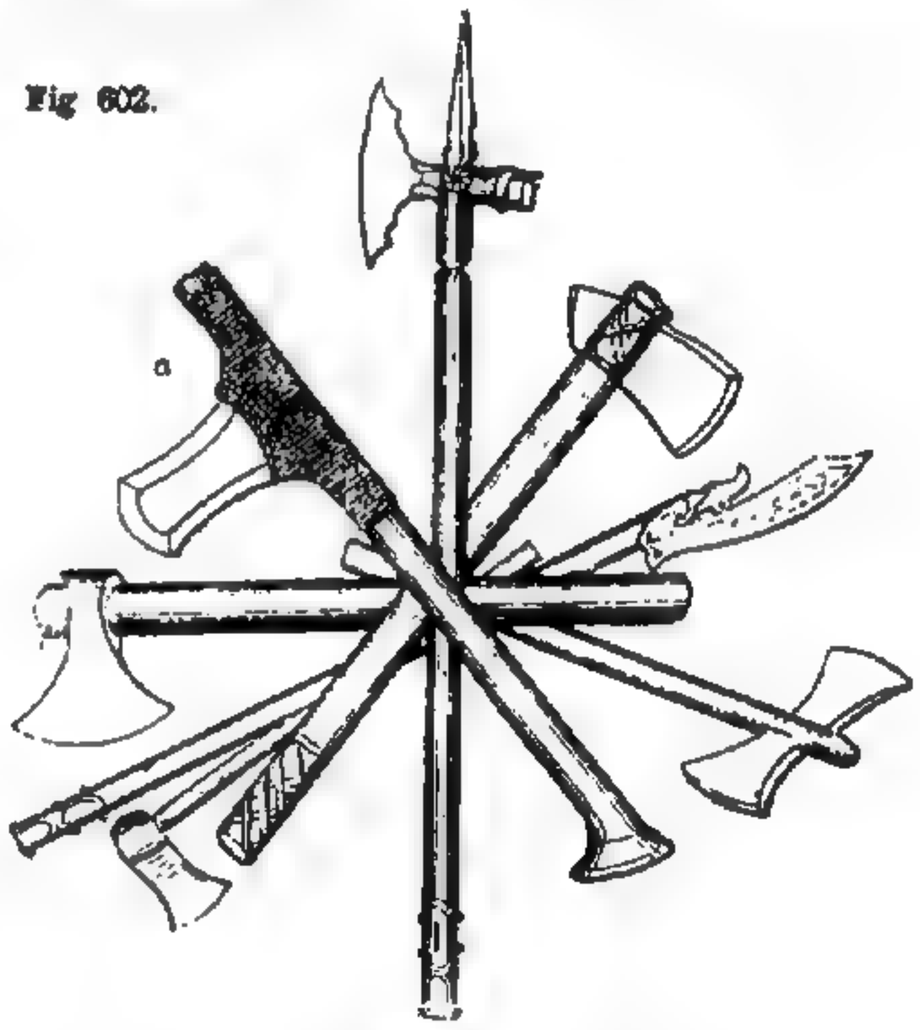
Fig. 599.



Gatling Gun (Front View.)

Arrangement is made for horizontal adjustment to deliver a sweeping fire.

Fig 602.



Battle-Axes.

Bat'tle-axe. This military weapon is of very remote antiquity, being made of stone before the discovery of metals. (See AXE.) It was used by the Sacæ, who formed a part of the forces of Xerxes. Brennus, the Gallic king, who captured Rome, was armed with a battle-axe, and in remote ages it appears to have been considered peculiarly as the weapon of an uncivilized people. It was, however, extensively employed during the Middle Ages, and was in use as late as the sixteenth century, when attempts were made to improve it by attaching a pistol to the handle.

a, battle-axe from Dr. Abbott's collection of Egyptian antiquities in New York; made of bronze, firmly bound to its original handle by means of slender interlaced thongs of leather. It was found at Thebes.

The other figures represent battle-axes, more or less rude, of the times known as the "Roman period" and the "Middle Ages."

Bay'o-net. A piercing weapon, fixable on the muzzle-end of a fire-arm. They were originally made at Bayonne, in France, in the latter half of the seventeenth century, and used by that nation in the Netherlands in 1647. The weapon was introduced into the English army in 1672, and used at Killiecrankie, in Perthshire, where the forces of William of Orange, commanded by Mackay, were defeated by those of James II., under the command of Graham, of Claverhouse, 1689; and also at the battle of Marsaglia, 1693, "with great success against the enemy, unprepared for the encounter with so formidable a novelty."

The first known bayonet was a kind of long and slender rapier, with a wooden handle, or plug, which was inserted into the muzzle of the musket. Previous to this it had been customary to distribute musketeers among the pikemen, the two mutually supporting and assisting each other. The above-named arrangement for fixing the bayonet does not seem to have prevailed long, and was soon superseded by a slotted socket on the lower part of the bayonet, which slipped over the muzzle of the musket and was held in position by a stud on the barrel. The ring-bayonet was introduced in 1693, and the socket-bayonet in 1703. This form continued in use for about 150 years, an annular clasp and screw being added about 1842 in the United States service.

The "sword" bayonet *b* seems to be of very recent origin, having been first recognized in the United

Fig. 602.

Bayonets.

States army in 1856. Its utility as a weapon is very questionable. It is believed that this form of bayonet was first introduced in the French service among the Chasseurs de Vincennes, who used it in Algiers, in the Crimean campaign of 1854–55, and the Italian war of 1859.

It is secured to the rifle by a ring in the guard and a spring-catch in the hilt.

The *saw-bayonet*, having a sword edge and a saw back, is now being tested for the British arms. The *spade-bayonet* has also its advocates, it being intended to enable the soldier to intrench his position. The tendency seems to be to beat their spears into trowels and their swords into pruning-saws, but the peaceable intention is not apparent. See INTRENCHING TOOLS.

The bayonet-blade is forged under a trip-hammer, after which it is rolled to a proper form by sets of rollers adjusted to give it the required shape and taper. The socket is then forged, and the two portions welded together. It is next twice swaged by the "drop," then ground and polished; the former on a stone, and the latter on wheels bound with leather and covered with emery. The bayonet is rigidly gaged, and then tested by weight and by blow to determine its soundness and temper.

The Rice trowel-bayonet, the in-

Elcho and Rice Bayonets.

Fig. 246.

vention of Col. Edmund Rice, and the Elcho saw bayonet, invention of Lord Elcho, are shown in Fig. 246. It has been proposed to issue them in certain proportions to troops. See "*Ordnance Report*," 1872, 1873.

The Snider bayonets for the British Government, triangular in section, are forged from $1\frac{1}{16}$" round steel bar, which is drawn down under a power hammer, about 4" remaining untouched to form the socket. The bar is next bent or "broken down," as the term is, in two places. After being cut off from the bar, sufficient metal being left for the blade, it is stamped in a pair of dies; the blade is then drawn out by the hammer. The rolling is performed by Barnes' patent rolling machines, in which there are two horizontal spindles, each carrying four cams, in which the dies are fixed. These cams occupy about one third of a circle; and the dies, which are cut on the periphery, are set so as to give the required thickness to the bayonet blade. After the bayonet has been trimmed, it is hardened and ground. The socket is next drilled and milled, the slot for forming the attachment to the rifle being afterwards cut; and after the further operation of "blueing" and polishing, the bayonet is complete.

Bay'o-net-clasp. A movable ring of metal surrounding the socket of a bayonet, in order to strengthen the socket and render the bayonet less easily detachable.

Bay'o-net-joint. A peculiar form of coupling, in which one circular piece, having a slot longitudinal for part of its length and transverse the remainder, is sleeved over another. The interior piece is provided with a stud which enters the slot, and, by turning, the two parts become locked so as to prevent withdrawal by a longitudinal movement.

An *open bead* has a circular opening through a bead somewhat larger than a solid one. Also called *Aperture* sight.

Combined sometimes with a *bar*. See BAR AND BEAD SIGHT.

Fig. 249.

Bead. *Open Bead.*

Blast'ing. The process of rending rocks, etc., by means of boring, filling the hole with an explosive, and then firing it off. Improvements appertain to the modes of drilling the holes, the composition of the explosive, and the means of igniting.

Gunpowder is said to have been first used for blasting in Germany or Hungary, A. D. 1620; and some German miners, brought to England by Prince Rupert, introduced the practice at the copper mine of Eckford, in Staffordshire, the same year.

The preliminary operation in blasting consists in boring or drilling holes, in which are to be placed the charges of gunpowder or other explosive mate-

rials employed to rend the rock.

The implements ordinarily used for this purpose are the jumper, or drill, the hammer, and the scraper. The jumper is a bar of iron, in length proportioned to the depth of hole to be bored, and is faced with steel for a part of its length : those of 1½ inches diameter and upward are worked by three men, two of whom strike alternately on the end of the jumper with hammers, while the third turns it so as to constantly present the cutting edge to a fresh surface of stone.

This is a slow and laborious operation, experience having shown that in granite three men working as above with a jumper of 3 inches diameter, such as is used for boring holes from 9 to 15 feet deep, would not penetrate more than about 4 feet per day on an average ; or with a 2½-inch jumper, 5 feet per day, the last being employed for holes from 5 to 10 feet deep.

Churn-jumpers are so called from the manner in which they are worked, by a vertical churning or pounding movement, no hammer being employed ; they have a steel bit at each end, are usually worked by two men, and are generally of smaller diameter than those which are worked by a hammer ; in drilling holes that are vertical or nearly so, and in moderately hard rock, they are found more advantageous than the others, two men being able to bore about 16 feet per day with a churn-jumper of 1⅛ to 1½ in diameter. They are sometimes used with a spring rod and line, much in the manner of the most primitive way of boring artesian wells.

General Burgoyne mentions seeing the same device in use in blasting the calcareous rocks of Marseilles, at the foot of the hill on which the fort of Notre Dame de la Garde now stands.

The common way of charging the hole is, where the moisture is not excessive, to pour loose powder into it to a certain depth, depending on the judgment of the miner (one third the depth of the hole is a common allowance under ordinary circumstances) ; the needle, which is a wire sufficiently long to reach well down into the charge of powder, and provided with a handle to enable its easy withdrawal, is then inserted and the hole tamped, a wad of hay, straw, dry turf, or other suitable material, being first placed over the powder ; the tamping is performed by ramming down small fragments of broken brick or of stone which does not contain silex to endanger striking fire, by means of an iron bar called a tamping-rod ; when the hole is tamped nearly up to the level of the ground, an inch or two of moist clay is usually placed over the tamping, and the needle withdrawn ; it may be remarked that the needle should be frequently turned as the ramming proceeds, so that it may be withdrawn without disturbing the tamping. The priming is effected by pouring fine grained powder down the hole left by the needle, or, what is better, straws filled with powder are pushed down, communicating with the blasting charge ; a bit of slow-match or touch-paper, calculated to burn long enough to allow the workmen to retire to a place of safety, is then ignited, and placed in contact with the priming.

In the construction of the Southeastern Railway 400,000 cubic yards of compact chalk were lifted from the face of the Round Down Cliff, two miles west of Dover, England, at a single blast.

Three charges were employed, placed in chambers, 70 feet apart, the center and largest one being placed at a salient point 72 feet, and those on each side each 56 feet distant from the face of the cliff. The charges of powder were 7,500 lbs. in the main chamber, and 5,500 lbs. in each of the others. Shafts tapering from bottom to top were driven downward from a driftway previously cut in the rock, and from the bottoms of these shafts galleries were cut at right angles to the driftway. These were also enlarged at their inner extremities, to secure the tamping. The chambers were cut at right angles to the galleries. After charging, a dry wall of chalk was built across the mouths of the chambers ; the galleries and shafts were tamped with the same material, and the tamping was extended into the driftway 10 feet on each side of each shaft. Three Daniell's batteries and three sets of wires were used for firing the mines, which was done simultaneously. The mass of rock removed averaged 380 feet in hight, 360 in length, and 80 in thickness. See ARTESIAN-WELL ; TUNNEL ; WELL-BORING ; and Specific Indexes under CIVIL ENGINEERING and MINING.

See Raymond's "Mines, Mills, and Furnaces" : J. B. Ford & Co., N. Y., 1871. Blake's "Mining Machinery" : New Haven, 1871. Also, "Blasting and Quarrying of Stone and Blowing up of Bridges," by Lieutenant-General Sir J. Burgoyne of the English Military Engineers. No. 35 of Weale's Rudimentary Series : London.

The following table from General Sir Charles Pasley's "Memoranda on Mining" will give the means of calculating the space occupied by any given quantity of powder in round holes of different sizes, from one to six inches : —

Diameter of the hole.	Powder contained in one inch of hole.		Powder contained in one foot of hole.		Depth of hole to contain 1 lb. of powder.
Inches.	lb.	oz.	lb.	oz.	Inches.
1	0	0.419	0	5.028	38.197
1¼	0	0.942	0	11.304	16.976
2	0	1.676	1	4.112	9.549
2¼	0	2.618	1	15.416	6.112
3	0	3.770	2	13.240	4.244
3¼	0	5.131	3	13.572	3.118
4	0	6.702	5	0.424	2.387
4¼	0	8.482	6	5.784	1.886
5	0	10.472	7	13.664	1.528
5¼	0	12.671	9	8.052	1.263
6	0	15.080	11	4.960	1.061

The following table shows the quantity of powder required to lift from its bed rock of usual weight (about 1⅝ tons to the perch) and ordinary consistence.

Line of least resistance.	Charges of powder.		Line of least resistance.	Charges of powder.	
Feet.	lb.	oz.	Feet.	lb.	oz.
1.0		½	4	2	0
1.6		1¾	4.6	2	13½
2.0		4	5	3	14½
2.6		7¾	6	6	12
3.0		13½	7	10	11½
3.6	1	5½	8	16	0

The obstruction known as Blossom Rock in the harbor of San Francisco was removed by constructing a coffer-dam around a portion of the rock, a po-

rous sandstone, and excavating its interior, leaving a shell about 6 feet thick, supported by props, to resist the pressure of the water. The space excavated measured 140 by 50 feet, and varied in depth from 4 to 29 feet. 23 tons of powder were used, part of which was inclosed in water-proof casks, and the remainder in iron tanks. These were connected by insulated wires with an electric battery. When all was ready, the coffer-dam was removed, and the water permitted to fill up the excavation, acting as a tamping. The result is represented to have been entirely successful.

Maillefert's process in removing *Way's Reef* in the Hurl-Gate (Hell Gate) obstruction, on the East River, N. Y., consisted in depositing a quantity of powder on the surface of the rock to be removed, and then exploding it. There is no cumbrous apparatus used. A sounding-pole to ascertain the depth, a boat to contain the operators, and an electric battery, are the machinery employed. The explosion is effected by electricity, and it is the same thing whether the operators are stationed near or far, they need never be in danger.

The force of the current is such as to render it difficult to fix drilling apparatus. The process was successful on prominences and to a certain extent; where a broad area was flat, the value of the process rapidly diminished.

Shelburne's apparatus on the *Frying-pan Rock*, in the same estuary, was a heavy stamping-drill, operated by a steam-engine, and acting in a tube which directed its blows; the hole obtained receiving a charge of nitro-glycerine.

The work of removing the obstructions in the East River has now devolved upon the United States Engineers, under General Newton. They are proceeding by building coffer-dams and driving headings. It is a regular tunneling business, and when the whole roof is blown off and the pillars broken off, the new river-bottom will be the bottom of the drifts, plus what of the rock may fall back into the hole. Such can be grappled and removed.

Nitro-glycerine, dualin, dynamite, and various other compounds of terrific energy, are used in these great engineering projects. It is understood that nitro-glycerine has been the principal agent in the Mount Cenis tunnel, as it has been for some years past in the Hoosac.

The idea of blasting by a torpedo in the bottom of an oil-well, to open crevices and increase the flow of oil, seems to have been entertained by a number of persons, including Professor Hare, but was reduced to practice by Colonel Roberts. See TORPEDO.

Blast'ing-fuse. The common blasting-fuse is merely a tube filled with a composition which will burn a sufficient length of time to allow the person firing it to reach a place of safety before it is burnt out.

Safety-fuse, by which the charge can be fired by a man at a considerable distance, is also generally employed. Some of these consist of a tape of soft material saturated with a highly inflammable compound (fulminates are, we believe, employed in some to increase the speed of the flame), and covered with an envelope of water-proof material. Firing by electro-battery is much safer.

Blast'ing Gel'a-tine. A new explosive agent, discovered by M. Nobel. This substance, called in England, "*Blasting Gelatine*," is formed by dissolving collodion cotton in nitro-glycerine in the proportion of 10 per cent. of the former to 90 per cent. of the latter. The result of the solution is a gelatinous, elastic, transparent, pale-yellow substance, having a density of 1.6, and the consistence of a stiff jelly. The new explosive is in itself much less easily affected by blows than ordinary kieselguhr-dynamite; but it may be rendered far more insensible to mechanical impulse by an admixture of a small proportion (from 4 to 10 per cent.) of camphor. Experiments have been carried out, the result of which is to prove that the new explosive possesses, weight for weight, 25 per cent., and bulk for bulk, 40 per cent. more explosive power than ordinary dynamite. With moist gun-cotton, gelatine compares nearly as favorably.

Blast'ing-nee'dle. A long taper piece of copper, or iron with a copper point; used when tamping the hole for blasting, to make by its insertion an aperture for a fuse or train.

Blast'ing-pow'der. It was formerly thought that a slow-burning powder, containing a comparatively small proportion of niter, — about 62 per cent, — was more effective for blasting purposes, allowing more time to produce a rending effect upon rock before being consumed than the quicker and stronger powder used in fire-arms; but the tendency now is toward the use of substances of far greater rapidity of ignition, and greater expansion in the act of assuming the gaseous state, than even the strongest gunpowder.

Among more than thirty patented compositions for blasting powder are the following ingredients. The specific combination in each case might be given would space permit.

1. Forms of carbon: —

Burnt cork.	Gambier.
Charcoal.	Brown coal.
Lycopodium.	Peat.
White sugar.	Logwood.
Sawdust	Bark.
Horse-dung.	Carbolic acid.
Starch of flour.	Aloes.
Petroleum products.	Paraffine.
Cutch.	Fatty matters.
Tannin.	Resins.

2. Metallic salts, etc.: —

Chl. potash.	Carbonate of soda.
Red sulph. arsenic.	Nitrate of lead.
Ferro-cyan. potassium.	Ammoniacal salts.
Nitrate of potassa.	Nitrate of soda.
Sulphur.	Carbazotate of potash.
Chloride of sodium.	Azotate of potash.
Cyanuret of zinc.	Nitrate of iron.
Barilla.	Nitric acid.

Blast'ing-tools. Baron Liebhaber of Paris obtained a patent in France, 1845, for a mode of enlarging the lower part of a blast-hole by the application of muriatic or other acid 1 part, diluted in water 3 parts.

A tube (*k*, Fig. 708) is inserted in the hole and externally sealed around the lower end with a com-

position which prevents the rising of the vapors of the acid in the space between the tube and the sides of the hole. The acid is poured into a funnel and down an inner tube, the annular space forming a duct for the escape of the gas, the spent liquid escaping at a bent spout. The hole is then emptied by a siphon or pump, and dried to prepare it for the charge.

The principal blasting tools are —

The *hammer*, for striking the borer.

Borer, or *jumper*. *Drill*.

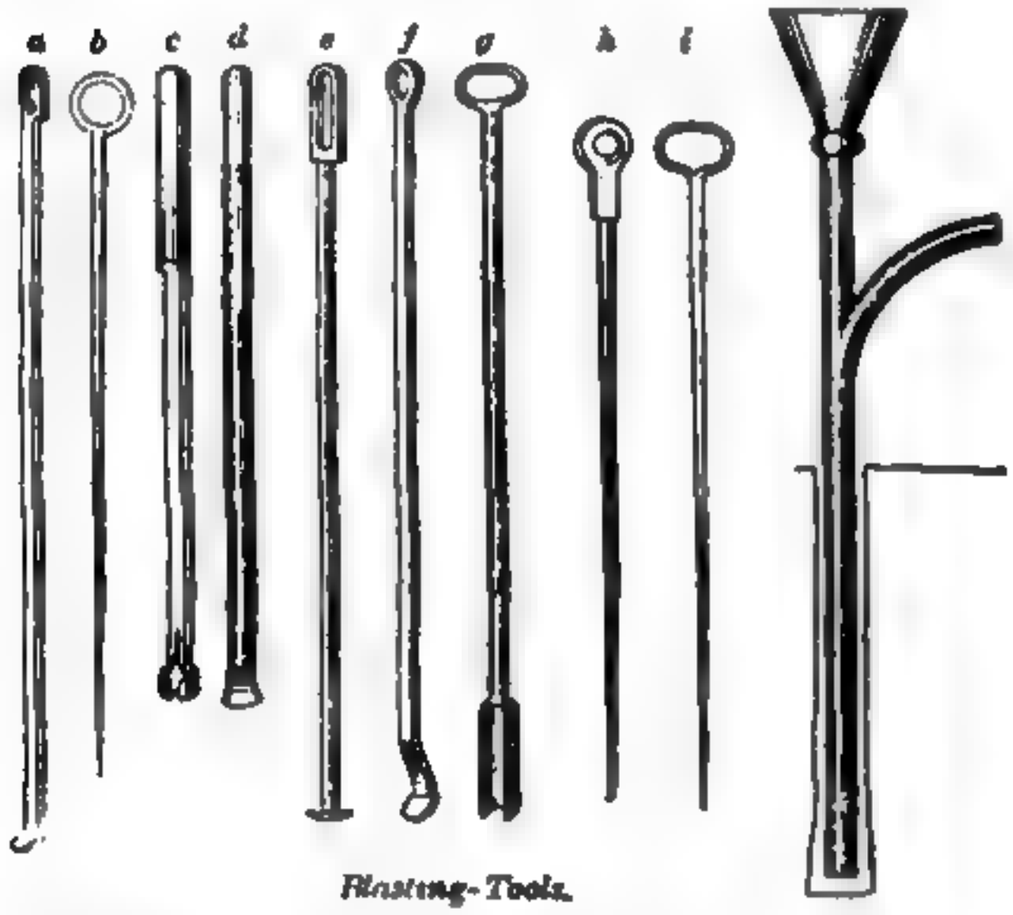
Gad; a wedge for driving into openings made by a pick.

Pick.

Scraper; for clearing the hole.

Needle, or *priming-wire;* a thin copper rod whose

Fig. 708.



Blasting-Tools.

withdrawal leaves a vent whereby the charge is reached.

Claying-bar, *tamping-iron*, or *rammer:* for driving down the tamping.

The *fuse*, or *match*.

a e f, scrapers for clearing the blasting-hole.

b h i, needles for pricking the cartridge.

c, tamping-bar. *d*, drill. *g*, bar for ramming in the cartridge.

k, funnel and pipe for introducing acid to enlarge the bottom of the hole.

Bolt. (*Fire Arm.*) 1. The sliding piece in a needle-gun which drives home the cartridge, and carries in its axial recess the firing pin.

Bomb. (*Ordnance.*) A spherical hollow shot, fired from a *mortar* or *howitzer*, and filled with explosive material which is lighted by a *time* or *percussion fuse*.

Bombs were used at the siege of Naples in 1434. Mortars for bombs were cast at Buckstead, England, 1543. See SHELL.

Bom'bard. (*Ordnance.*) An ancient mortar of large bore, used to throw stone shot.

Bomb-shell. A spherical or cylindrical case of iron loaded with powder, and burst by its charge on concussion or after an interval of time. See SHELL.

Bow. 1. (*Archery.*) An instrument for projecting an arrow. It consists of a strip of wood or other material, the ends connected by a string. The bow is bent by retraction of the string, and the recoil imparted to the latter projects the arrow. In its simple state, and when large enough to be used for military purposes or for destroying large animals, it is known as the long-bow; when mounted transversely in a stock, it is a cross-bow. The former is exclusively adapted for shooting arrows; while bolts, or even round projectiles, may be thrown by the latter.

The long-bow, owing to its greater portability and capability of rapid discharge, was a much more effective weapon than the cross-bow, and continued in use for a long time after the introduction of fire-arms. The English archers, like the Egyptians in the time of Rameses the Great, were taught to draw the arrow to the ear, instead of to the shoulder, as was the practice elsewhere, and hence constituted a most effective species of force almost unknown in the other armies of Europe. 220 yards from the butt or target was the smallest distance allowed for practice by a full-grown man, according to the English archery-statutes. The cross-bow, as used by the Genoese, whose archers were in high repute in the Middle Ages, was a cumbrous and heavy weapon bent by a small windlass, and incapable of rapid loading and discharge.

The use of the bow is of great antiquity. Plato credits Apollo with the invention. Ishmael became an archer (Gen. xxi. 20). The Philistine archers overcame Saul (1 Sam. xxxi. 3). David commanded it to be taught (2 Sam. i. 18). Aster of Amphipolis shot Philip of Macedon, and was hanged therefor. An ancient Egyptian bow is preserved in the Abbott Museum, New York, together with the leather case that contained it and fastened it to the war-chariot. Four arrows, made of reed and tipped with flint-stone, are suspended with it.

The Scythian bow was remarkable for its great curvature, being nearly semicircular.

The Lycian bow was made of the cornel-tree; those of the Ethiopians of the palm-tree. The horn of the antelope was used in the East for bows, at least as far back as the siege of Troy, and is still employed for the purpose. The English long-bow was made of yew or ash.

The Indian contingent of the army of Xerxes had bows of cane and arrows of cane with iron points. They wore cotton dresses. (Herodotus vii. 65.)

The arrow-heads of the Ethiopians were of agate and other siliceous stones. "Pieces of stone of the kind used in engraving seals."—*Ibid.*

The bows of the Ethiopians were of the stem of the palm-leaf.

Pliny says: "It is by the aid of the reed that the nations of the East decide their wars. Fully one half of mankind live under a dominion imposed by the agency of the arrow." The Eastern reed, so called, was a bamboo.

Harold, William Rufus, and Richard I. were killed by arrows. Crecy, Poictiers, and Agincourt were won by archers. The long-bow of that time measured six feet, the arrow three feet. The range was 300 to 500 yards.

In the Southwest of England bows and arrows did not finally disappear from the muster-roll till 1599. The muskets were such miserable affairs that in the middle of the fifteenth century it took fifteen minutes to charge and fire one.

Breech. 1. (*Fire-arms and Ordnance.*) The rear portion of a gun; the portion behind the chamber.

2. (*Shipbuilding.*) The outer angle of a knee-timber; the inner angle is the *throat*.

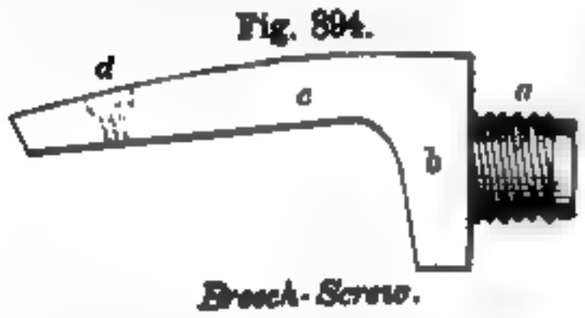
Breech-block. A movable piece at the breech of a breech-loading gun, which is withdrawn for the insertion of a cartridge and closed before firing; to receive the impact of the recoil. This is the great problem in the breech-loading gun. Under FIRE-ARM the subject is treated, the invention being divided into 2 genera, 91 species, and 21 varieties, according to the mode of moving the block relatively to the barrel or the barrel to the block. The problem is to open the rear of the barrel and close it again. See FIRE-ARM.

Breech-load'er. A fire-arm in which the load is introduced at the rear instead of at the muzzle. The use of breech-loaders goes back to the sixteenth century; indeed, it is probable that that form of arm is about as old as the muzzle-loader. See FIRE-ARM; REVOLVER; MAGAZINE-GUN; CANNON. See also list under WEAPONS.

Breech-pin. (*Fire-arms.*) A plug screwed into the rear end of a barrel, forming the bottom of the charge-chamber. Otherwise called a *breech-plug* or *breech-screw*.

Breech-screw. (*Fire-arms.*) The plug which closes the rear end of the bore of a fire-arm barrel. The parts are known as

Fig. 894.



Breech-Screw.

a, plug.
e, face.
b, tenon.
c, tang.
d, tang-screw hole.

Breech-sight. (*Fire-arms.*) The hinder sight of a gun. In conjunction with the front sight it serves to aim the gun at an object. It is graduated to degrees and fractions, their length on the scale being equal to the tangents of an arc having a radius equal to the distance between the front and rear sights. The front sight is merely a short piece of metal screwed into the gun, usually at the muzzle, but sometimes between the trunnions, or on one of the rimbases, with its upper edge parallel to the bore of the gun. The rear sight may be detached, having a circular base fitting the base of the gun, or may slide through a slotted lug, and be retained at any given hight by a set screw.

The *breech-sight*, the *tangent scale*, and the *pendulum* are merely different forms of this device, the latter having a bulb at its bottom which keeps it in a vertical position when the two wheels of the carriage are not at the same level. It is suspended in a seat which is screwed into the breech of the gun. The tangent scale has steps, corresponding in hight to the graduations on the breech sight for guns of the same caliber and pattern; and is only applied to the gun at the moment of sighting. See BACK-SIGHT.

Bul'let. (From the French *boulet*, diminutive of *boule*, a ball.) A small projectile for fire-arms.

The use of round bullets dates back to the time when gunpowder was first used in ordnance. Bullets are now usually cylindrical, with conical or conoidal points.

In 1418, four thousand bullets were ordered to be made of stone from the quarries of Maidstone, England. These were probably for cannon, as were the iron ones mentioned in Ryder's "Fœdera," 1550.

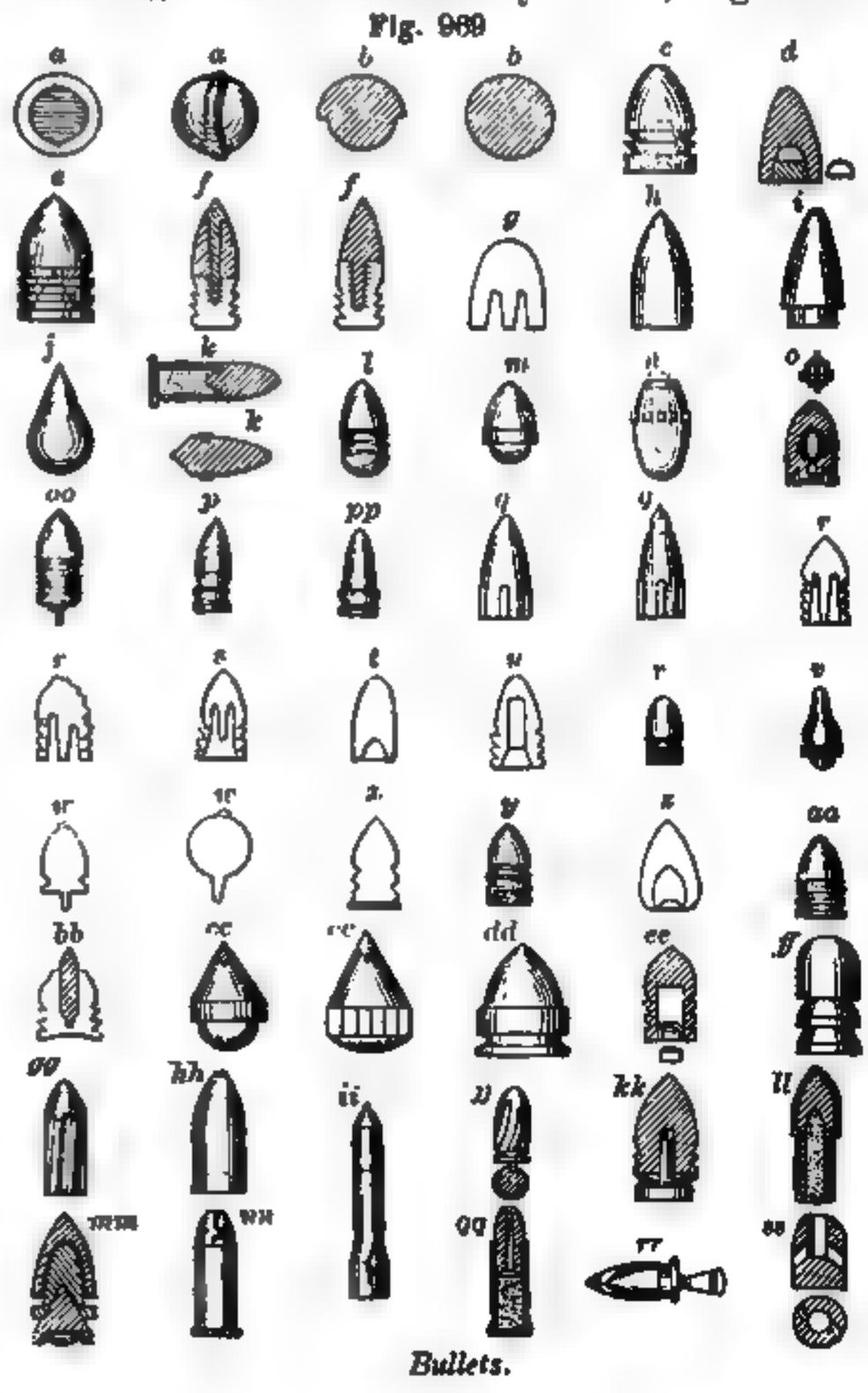
The trajectory of a bullet is the line described by its center on its passage through the air. It would be a parabolic curve in a vacuum, but the resistance of the atmosphere greatly modifies this and reduces the range, so that a 24-pdr. cannon-ball, fired at an angle of 45°, with an initial velocity of 1,400 feet per second, ranges only some 2,100 yards instead of more than 20,000, as it would do if the atmosphere offered no resistance.

The actual velocity of the smooth-bore musket round ball, weighing 412 grains, with a charge of 110 grains powder, at the time of leaving the gun, has been found to be 1,500 feet per second, and that of the elongated ball, cal. .58 of an inch, with 60 grains of powder, 963 feet; but though the latter has so much less velocity at the time of leaving the gun, its range is at least equal and its accuracy far superior.

The greater accuracy of the rifle is due to the fact that the rotary motion given the bullet by the spiral grooves of the gun keeps it always point foremost, and that the bullet is caused to completely fill the bore so that it leaves it in a line with the axis of the piece, which rarely happens in a smooth-bore gun, owing to the difference in diameter between the bullet and the bore.

The rifle was introduced by Koller, a gunsmith

Fig. 969



Bullets.

of Nuremberg, about the beginning of the 16th century, and the increased accuracy given by this species of arm was soon appreciated; and from the fact of a troop of horse known as Carabins having been armed with them, the weapon itself was subsequently called carbine.

The round ball, however, still held its place until very recently, both for rifled and smooth-bore guns; and it was not until the wars of the French in Algeria, subsequent to 1830, that experiments on an extended scale were made as to the practicability of using that form of projectile, the pointed and elongated, which both mathematics and common-sense showed to be best adapted to both accuracy and long range.

Among the first of the improved balls was the Brunswick (*a*, Fig. 969), which had a circumferential belt, and was adapted for a two-grooved rifle. *b b* is the Delvigne, adapted for a sub-caliber powder-chamber, and resting by an annular shoulder upon a wooden sabot. It had a patch of greased serge. Minie and Thouvenin introduced an elongated bullet with a cylindrical grooved body and a conical point. This had a greased paper patch, and was expanded to fill the grooves by being driven down upon a *tige* in the breech of the gun. This was adopted in the French service in 1846. Delvigne subsequently patented an elongated bullet with a recessed base which he called the *cylindro-ogival*.

Minie, in 1847, produced the well-known bullet *c*, in which the *tige* was dispensed with, and the bullet expanded by the explosive force of the powder in the cup, which was inserted into a frusto-conical cavity in the base of the bullet. The English substituted a conoidal wooden plug in their Enfield-rifle bullet *d*.

In 1856, after a series of experiments by the Ordnance Department, an elongated bullet *e*, with a cavity, was adopted for the United States army. The diameter is .577 of an inch, that of the arm for which it is intended being .58 of an inch. Two varieties were made, both being precisely similar on the exterior, but differing in the size of the cavity; that for the rifle-musket weighing 500 grains, and the other for the pistol-carbine but 450 grains.

f f is the bullet of Thirouse, a French artillery officer. It is composed of lead backed by a sabot of wood with three circular grooves near its base. The Nesler ball *g* was intended for a smooth-bore.

Of the other bullets in Fig. 969, some are celebrated on account of the ingenuity or success of their inventors, others as having been adopted by different governments.

h is the American conoidal pointed bullet.

i, the Colt, with a rabbet for the cartridge capsule.

j, the American "picket," with a hemispherical base.

k k, Haycock's Canadian bullet, with a conoidal point and a conical base.

l, Mangeot's bullet with a conoidal point, hemispherical base, and two circular grooves.

m, the Prussian needle-gun bullet.

n, Norton elongated percussion rifle-shell, fitted with wooden plug (1830).

o, Gardiner's explosive shell-bullet, cast around a thin shell of copper attached to a mandrel, which is afterwards withdrawn, leaving a fuse-hole in the rear through which the charge is exploded in about 1½ seconds.

oo is a Spanish bullet containing a charge of powder and a fulminate.

p is the Swiss federal bullet.

p p, the Swiss Wurstemberger bullet.

q and *q* are views of the Jacob's bullet and shell.

r and *r* are views of the Peter's ball, having an interior tige; one view shows it distended and battered.

s is the Belgian bullet.

t, Pritchell's bullet.

u, Mangeot's bullet.

v v, Austrian bullets.

w w, Deane and Adams's bullets, with tails.

x, English bullet, with wad.

y, Sardinian bullet.

z, Beckwith's bullet.

a a, steel-pointed bullet.

b b, the Charrin bullet, with zinc or steel point.

c c, *c c*, Tamisier's steel-pointed bullet; one view showing it intact, and the other after compression in the grooves of the rifle.

d d, the Saxon bullet.

e e, the Baden modification of the Minie, with tinned iron cup.

f f, Wilkinson's bullet.

g g, Whitworth's hexagonal bullet.

h h, Lancaster's bullet.

i i, Mefford's sub-caliber bullet, with spiral grooves on the shoulder to impart rotation.

j j, McMurtry's bullet, with spiral grooves.

k k, Williams's bullet, with a headed tige to expand a rounding disk at the base.

l l, Dibble's bullet, with a recess for the powder.

m m, Shaler's triple bullet, the pieces of which are intended to diverge after leaving the muzzle.

n n, Maduell's bullet, which is built up of interlocking portions, which part as they leave the capsule and muzzle.

q q, Shocks's perforated bullet, with a sabot in the rear.

r r, Hope's bullet, with a bent tail to direct it in a curved path.

s s, Matteson's bullet, with spiral openings through it.

The following table shows the number of spherical leaden balls in a pound, from 1-⅛ to .237 of an inch diameter:—

Diam.	No.	Diam.	No.	Diam.	No.	Diam.	No.	Diam.	No.
Inch.		Inch.		Inch.		Inch.		Inch.	
1.67	1	.71	13	.488	40	.329	130	.265	250
1.326	2	.693	14	.469	45	.321	140	.262	260
1.157	3	.677	15	.453	50	.314	150	.259	270
1.061	4	.662	16	.426	60	.307	160	.256	280
.977	5	.65	17	.405	70	.301	170	.252	290
.919	6	.637	18	.395	75	.295	180	.249	300
.873	7	.625	19	.388	80	.29	190	.247	310
.835	8	.615	20	.375	88	.285	200	.244	320
.802	9	.57	25	.372	90	.281	210	.242	330
.775	10	.537	30	.359	100	.276	220	.239	340
.75	11	.51	35	.348	110	.272	230	.237	350
.73	12	.505	38	.338	120	.268	240		

Bul'let-la'dle. One for melting lead to run bullets. It is usually a hemispherical ladle with a spout, but in one case the ladle has a hole in the bottom guarded by a spring plug and

operated by a trigger on the handle; in another case a part of the ladle is covered, and the lead thus flows out at a guarded opening which keeps back the dross of oxide.

Bul'let Ma-chine'. (*Cartridges.*) Lead is fed in bars, which are 2′ or 3′ long, and have the diameter of a bullet; the compressing and shaping dies cut off pieces, compress and shape them.

British, "*Ordnance Report*," 1877, Appendix L., p. 563 and Figs. 97*x* 97*z*. The process is about as follows: —

At Woolwich: The melted metal is poured into a receiver, and as soon as it solidifies, but before it is cold, it is forced by hydraulic pressure through cylindrical holes in the form of long strings. This process is to prevent the formation of air bubbles in the bullet, which would cause it, when fired, to swerve from its course. The leaden strings are thence carried to the bullet-molding department, where they are cut into lengths and roughed; then shaped in one machine, and finished in another. They have now to be plugged. These plugs were formerly made of wood, but are now prepared from a special powder, which solidifies after being pressed into form.

Bul'let-mak'ing Ma-chine. Leaden bullets, as well for the military service as for other purposes, were formerly all made by casting.

The most common form of bullet-mold, where large numbers of bullets were required, was precisely like the common bullet-mold, but casting four, six, or more bullets. The gates were afterward cut off and the bullet trimmed by hand. The whole process was slow, and required a comparatively large number of hands.

To increase the rapidity of fabrication, revolving bullet-molds were tried, consisting of a cylindrical ring, to which revolution was imparted by a hand-crank and gearing, the molten lead being fed to the mold during its revolution; the gates were cut by a knife attached to the mold at the same operation; when full, the mold was opened and the bullets discharged, after which the mold was clamped shut again and the operation recommenced. These contrivances were ingenious, but were very liable to get out of order.

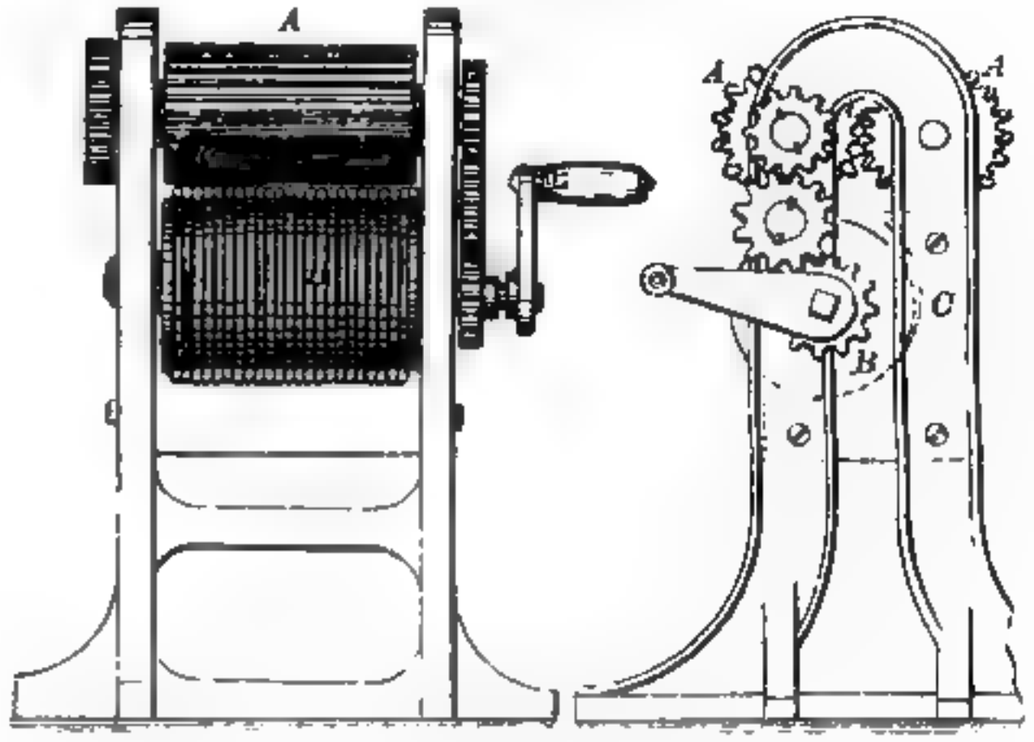
In 1857, De Zeng invented a mold for elongated bullets, constructed very similarly to the ordinary bullet-mold on a large scale, but which was mounted on a stand and worked by means of a treadle, through which, aided by the hands of the operator on the handles, the mold was opened and closed, and the gates cut off. This was an ingenious and efficient apparatus, and, with the aid of a boy to pour the lead, could be worked with great rapidity, seemingly limited only by the time required for the cooling of the metal at each cast.

Pressed leaden bullets are undoubtedly superior to cast ones, and those for the ordinary arms in the military service are made in the former way. The lead is generally procured in the form of "bullet wire," coiled on reels. This is cut in lengths of 25 inches, and fed to the machine by a boy. Elongated bullets are formed by a three-part die, which opens and closes with great rapidity, delivering the bullets at the rate of about 3,000 per hour; these have a slight burr or feather at the points where the dies come together, which is afterwards trimmed off by hand.

Molds and rolls are provided with each machine, so that the bars may be cast from the pig, and rolled to give them density; but, as observed above, the lead is generally procured in the form of wire. It is estimated that a man can cast 1,500 bars, or trim and roll 2,000 bars, in a day of ten hours.

BRUFF'S machine, 1813, has a furnace and a press, in which respectively the lead is cast into

Fig. 971



Bruff's Bullet-Compressing Machine.

ingots and made into round bullets. The figures are side and end views of the press. The lead is cast into flat plates of the required thickness, and of a width equal to the length of the rolls. It passes from above, downward, between the upper pair of rolls *A*, which are grooved longitudinally; by them it is pressed into round rods, — or, more correctly, long cylindrical pieces, — one half of each of which is formed by the groove in the face of one roll, while the other half is formed by the corresponding groove in the opposite roll, the two working in apposition and moving at an equal rate. Each bar, as it falls from the upper rolls, alights upon the lower roll *B*, which is grooved circumferentially, and carries the round bar against the curved steel plate *C*, whose face is grooved in correspondence to the grooves of the wheel *B*. The bar is nipped between the surfaces, and is cut into sections by the adjacent edges of the roll and plate, and as the pieces roll down in the grooves of the plate and are pressed on the opposite sides in the grooves of the roll, they gradually assume a perfectly spherical form and are discharged.

The elongated shot or bullets now used for rifles are made at Woolwich in the following way: The machine for this purpose consists of four sets of duplicate punches and dies, independently worked in pairs by two eccentrics, driven by gearing from two separate driving-shafts. The lead, coiled round four reels, is fed from them through a shearing-lever into the grippers, where it is clutched; a piece is cut to a suitable length by an upward movement of the shearing-lever; the grippers then open, the piece cut off falls down, and is clutched by another piece of apparatus. At this moment a punch advances, and presses the lead into the die, thus forming a bullet. A small plate comes up immediately in front of the die, and the bullet is pushed through it by a small pin, worked by a lever and cam; by this operation the ragged edge is removed which had been left on the bullet by the die. The machinery, when driven at the rate of thirty revolutions per minute, will make 120 bullets in that time, or 72,000 in a day of ten hours.

Bul'let-mold. An implement opening like a pair of pinchers, having jaws which shut closely together, and a spherical or other shaped cavity made by a cherry-reamer, with an ingate by which the melted lead is poured in.

Bul'let Patch'ing Ma-chine'. A machine for enveloping the cylindrical portion of rifle bullets with paper, to prevent the "leading" of the grooves of the barrel.

In Borchardt's machine, the operating arrangements are on a circular table, supported by a hollow standard, through which an upright shaft passes from the actuating pulley that runs under a false floor. The connection is made by friction wheels, which insures the instant stoppage of the machine in case of any impediment. The bullets are fed to the machine by hand, and the patch is presented to the bullet and secured by a minute drop of mucilage, fed automatically, and is rolled closely around the bullet by the friction of flexible rolls, at the rate of 45 or 50 per minute, or about 20,000 per day of ten hours, including stoppages. Two operatives are required to run the machine properly. The action of the machine is easily controlled by means of a foot-lever and clutch. The machine may be adapted to all sizes and styles of rifle projectiles. The bullet-patches are cut out with dies. The patches require damping to insure neat and uniform folding.

Bul'let-screw. One at the end of a ramrod to penetrate a bullet and enable the latter to be withdrawn from the piece. See BALL-SCREW.

Bul'let-shell. An explosive bullet for small-arms. Jacobs's bullet-shells, used with the rifle of General Jacobs of the East India service, have an inclosed copper tube containing the bursting-charge, which may be fulminate or common powder, and is exploded by a percussion-cap or globule on striking.

In experiments made with them at Enfield in 1857, caissons were blown up at distances of 2,000 and 2,400 yards; and brick-walls much damaged at those distances by their explosion. See BULLET.

— C —

Cal'i-for'ni-a Sight. A hind sight for a gun;

Fig. 502

California Sight.

capable by elevation of the rear portion on one or other of the steps of the fin, of adjustment for ranges of varying distance. Fig. 502.

Cal'trop. (*Fortification.*) A pointed instrument to impede the progress of cavalry.

Fig. 1041

Caltrop.

It is a ball with four spikes, so arranged that, fall as it will, one is vertical and the other three stand as a tripod.

Bronze caltrops (*tribulus*) were used by the Romans.

Can'non. 1. A fire-arm of a size which requires it to be mounted for firing. As synonymous with *ordnance* or *artillery*, it includes great guns, howitzers, and mortars; the latter are pieces of relatively short bore and large caliber, for firing shells. Howitzers are short pieces with sub-caliber chambers, and are, in some respects, a grade between guns and mortars.

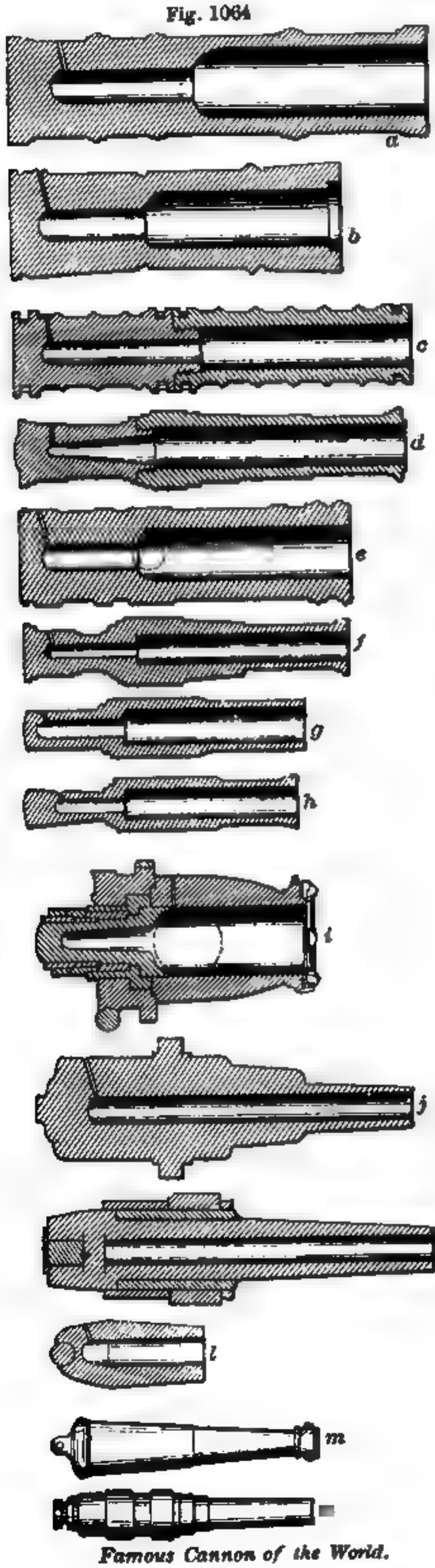
The name is derived from the same root as *canne* (Fr.), a reed; and the English words *can*, *cane*, *canal*, *canoe*, etc., which, with the German *kanne*, Latin *canna*, and Greek *Κάννα*, are presumably derivatives from some Sanscrit root signifying a tubular or hollow object. See HOWITZER; MORTAR.

The earliest cannon was doubtless Chinese, for thence came gunpowder. The history of cannon is the history of GUNPOWDER and of FIRE-WORKS (see under those heads). The nitrous efflorescence of the Tartar plains combined with the carbon of the argol fuel, and caused a sputtering beneath the pipkins of the nomads; curiosity and ingenuity combined the materials more intimately, and chance or care added the third ingredient, sulphur. Doubtless the paper cases and bamboos which were charged with the restless, fiery stuff were first of all intended for mere fireworks and dazzling exhibitions; but, as the art advanced, the intermittent firework was introduced, which discharged balls of fire at intervals. This appears among us as the *Roman candle*, — a very absurd name. By taking a tube of increased size, putting in a larger charge, and a missile on top of the latter, we have a fire-arm; and this may have been the condition of the matter when the advanced guard of Alexander was met in Northern India by a people who fought them with "balls of fire," as the ancient historian narrates. The word *canne*, a reed, is well chosen; for the original tube was a *reed* or *bamboo* in all probability, and was also called by that name. The thing and its title have kept well together for two or three thousand years. This sometimes happens, as in the case of two kinds of cloth well known in England, and to some extent here, *barracan* and *camlet*. Falstaff says: — "Two rogues in *barracan* (corrupted into *buckram*) set at me"; not knowing that he was talking Arabic, — *barrakân*, *barkân*, a garment of camel's hair, from *barik*, a camel. Our gossiping friend Samuel Pepys, and the more stately Sir William Temple, prided themselves on their *camlet cloaks*, which, if genuine, were even then made of camel's hair, as they were in the time of Esau and Jacob. The word is about the same, strange to say, in the Aramean and Aryan tongues (Heb. *gâmâl*; Ar. *gamal*; Greek, *καμήλος*), which may be accounted for by supposing that the Semitics received the animal and its name from its original proprietors, the men who crossed the Hindoo Koosh, and, occupying the country of the five rivers, became trading acquaintances of the Mesopotamian nations.

Reference to the use of the fire-driven balls occurs at intervals along the pathway of history, and there is but little doubt that the Greek emperors possessed some modes of projecting fire and explosives, perhaps balls, as early as the seventh century. Condé, in his History of the Moors in Spain, speaks of them as used in the attack on fortified places as early as 1118, and at the siege of Cordova, 1280. It is reasonable to suppose that, failing to enter Europe at the Byzantine Gate, the advent would be by the Pillars of Hercules, by which route arrived cotton, paper, clocks, medicines, the present (Hindoo) system of notation, and many other things, including the shirt, its name, uses, and materials (*chemise*; Sp.

camisa; Ar. *kamis;* not *shirt,* which only means *short,* and has nothing to do with it). Even the Arabic *kamis* betrays the origin of the stuff, being from the Sanscrit *kschauma,* a language of a different family from the Arabic, the name being evidently imported from India by the Arabs along with the material; for the *tree-wool,* as Herodotus calls cotton,

Fig. 1064



Famous Cannon of the World.

was known as an Indian production in the time of the "Father of History," whose credit grows brighter and brighter as years roll by, — tardy justice.

In the eleventh century, if we may credit the chronicle of Alphonso VI., written by Pedro, bishop of Leon, the vessels of the king of Tunis, in the attack on Seville, "had on board a number of iron pipes, out of which volumes of thundering fire were discharged."

In the fourteenth century the references to the uses of cannon became common. Ferdinand took Gibraltar from the Moors by cannon, in 1308. Petrarch refers to them about the same time. The English (at Crecy, 1346), the Moors, Arragonese, French, and Danes, used them during that century.

Metallic cannon were originally made by welding bars of iron longitudinally and binding them by rings, which were shrunk on over them while hot, — a plan which, with some modifications, has been revived of late years, and seems more feasible in the present state of the arts than it was 500 years ago.

Some of these ancient guns were breech-loaders, having a removable chamber, insertable in the breech, where it was wedged, for the purpose of containing the charge of powder.

The balls originally used were of stone, in some cases weighing 800 pounds or more, as is the case of the Mohammed II. gun, mentioned presently.

Fig. 1064 shows the relative sizes, and, to some extent, the mode of construction, of a number of the larger and more celebrated of the pieces of ordnance.

a is the *Tzar-Pooschka,* the great bronze gun of Moscow, cast in 1586. Bore, 122 in. long, 36 in. diameter; chamber 70 in. long, 19 in. diameter; total exterior length, 210 in.; weight, 86,240 pounds.

b, great bronze gun of Bejapoor, India, *Malik-I-Mydan,* the "Master of the Field." Cast in 1548. Bore, 28.5 in.; total length, 170.6 in.; weight, 89,600 pounds.

c, bronze cannon of Mohammed II., A. D. 1464. Bore, 25 in.; total length, 17 ft.; weight, 41,888 pounds.

d, the *Dulle-Griete,* of Ghent, Holland. Wrought-iron, made in 1430. Bore, 25 in.; total length, 197 in.; weight, 29,120 pounds.

e, great bronze gun of Agra, India, *Dhool-Dhanee.* Cast in 1628. Bore, 23.2 in.; total length, 170.2 in.; weight, 67,643 pounds.

f, wrought-iron gun, *Mons Meg,* Edinburgh. Made before 1460. Bore, 20 in.; total length, 159 in.; weight, 12,768 pounds.

g, Michelette le Grand, at Mont St. Michel. Wrought-iron, made in 1423. Bore, 19 inches.

h, Michelette le Petite, at the same place. Bore, 15 in.

i, Mallet's mortar, 1857–58. Bore, 36 in.; weight, 93,840 pounds.

j, English wrought-iron muzzle-loading 35-ton gun. Bore, 12 in.; weight, 48,400 pounds.

k, Krupp's breech-loading steel gun. Bore, 11 in.

l, sea-service mortar. Bore, 13 in.; weight, 11,200 pounds.

m, 68-pounder; weight, 10,740 pounds.

n, Armstrong breech-loader. Bore, 7 in.

For relative sizes of projectiles, see CANNON-BALL.

The names adopted for cannon in the fifteenth cen-

tury may be interesting: —

Name.	Weight of Ball.
Aspick	4 pounds.
Basilisk	48 pounds.
Bastard or ¾ carthoun	30 pounds.
Cannon royal or carthoun	48 pounds.
Culverin	18 pounds.
Demi-culverin	9 pounds.
Dragon	6 pounds.
Falcon	6 pounds.
Falconet	1 to 3 pounds.
Half carthoun	24 pounds.
Moyen	10 to 12 ounces.
Rabinet	16 ounces.
Saker	5 to 8 pounds.
Serpentine	4 pounds.
Siren	60 pounds.

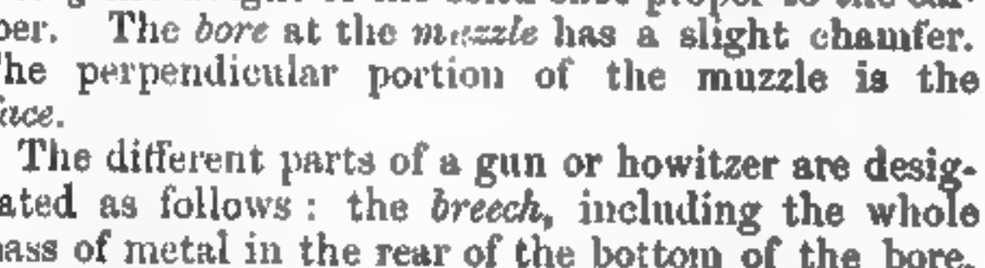
Cannon or ordnance as at present constructed, and used in Europe and America, may be divided into three classes: guns, or cannon proper, howitzers, and mortars. Carronades, which were a short, light species of cannon, intended for firing solid shot at short ranges, with small charges of powder, are now nearly obsolete. They were used on shipboard, and were principally distinguished by having no trunnions, being secured on their carriages or "slides" by a bolt passing through a lug or "navel" cast on their under side, and by a peculiar internal and external chamfer at the muzzle; the name is derived from that of the foundry on the river Carron, in Stirlingshire, Scotland, where they were originally cast.

Guns, as distinguished from howitzers or mortars, are intended for firing either solid shot, shells, or case-shot, generally at moderate elevations, and, in the case of smooth-bore guns, with comparatively high charges of powder, varying, according to the species of projectile and the object desired, to from ⅛ to ⅓ the weight of the solid shot proper to the caliber. The *bore* at the *muzzle* has a slight chamfer. The perpendicular portion of the muzzle is the *face*.

The different parts of a gun or howitzer are designated as follows: the *breech*, including the whole mass of metal in the rear of the bottom of the bore, and extending to the rear of the base-ring; the *cascabel*, including the base of the breech and knob; the reinforce, or reinforces, including the thickest part of the gun in front of the base-ring and extending forward to the *chase*, or conical part which terminates at the *neck*, or thinnest part of the gun, where the swell of the muzzle begins; or, should there be no swell, all the part in rear of the face of the muzzle is included in the chase. The *trunnions* are short journals which support the gun on its carriage, the width of which is determined by the distance between the *rimbases*.

In the accompanying section of a 32-pounder gun, from *A* to *B* is the *cascabel*, *A* being the knob of the

Fig. 1065



32-Pounder Sea-Coast Gun.

cascabel and *f* the *base* of the *breech*; *a* is the *base-ring*; from *a* to *C* is the first, and from *C* to *D* the second *reinforce*; from *D* to *E* is the *chase*, expanding into the *swell* of the *muzzle F*, which terminates in the *lip G*; *b* is the ellipsoidal bottom of the *bore*, indicated by the dotted lines; *c* shows the diameter and position of a *rimbase*, and *d* that of a *trunnion*. The diameter of the latter in guns is usually the same as that of the bore, and in howitzers, and mortars of the old pattern, as that of the chamber. *e* is the *chase-ring*, an ornamental fillet. The position of the *vent* is shown at *g*; its diameter is invariably two tenths of an inch. Rifled guns have a vent-piece of wrought-copper screwed into the piece.

Guns for use on ship-board have a slot in the knob of the cascabel to receive the *breeching*, a stout rope secured to ring-bolts in the side of the vessel for the purpose of checking the recoil.

Rifled cannon were first employed in actual service in Louis Napoleon's Italian campaign of 1859. General James's, 1861, were the first introduced into the United States service. These were service-pattern smooth-bores, rifled and furnished with projectiles also invented by General James. Captain Parrott's gun soon followed James's. This was constructed by shrinking a wrought-iron reinforce over the breech of a cast-iron core, and was noted for its fewness of grooves and smallness of caliber in proportion to the weight of the projectile, which was very elongated. Wiard's gun was of steel, hammered and welded, and was accompanied by a peculiar and novel carriage. The 3-inch "Ordnance" or Griffin gun was finally adopted for rifled field-artillery, and large numbers were in service at the close of the civil war in the United States. This is a wrought-iron gun weighing about 820 pounds, rifled with 7 grooves, and carrying a projectile weighing about 10 pounds. A cast-iron rifled siege-gun, 4½-inch caliber, and carrying a projectile weighing about 30 pounds, was introduced into the service at the same time.

About 1812, Colonel Bomford, U. S. A., introduced a chambered gun called by him the columbiad. These were made thicker at the breech and thinner at the muzzle than was then customary. This form was somewhat modified in the shell-guns of Colonel Paixhans, of the French army, about 1822, which found their way into the United States land-service at a later period under the name of sea-coast howitzers.

Experiment has gradually led to the practice of increasing the thickness of ordnance at the breech and reducing it at the muzzle, and making the resisting surfaces curvilinear. A large share of credit in this respect is due to the late Admiral Dahlgren, U. S. N.

The Rodman gun, from the late Colonel Rodman, U. S. A., resembles in general form the Dahlgren gun, but is cast with a core, through which a stream of water circulates while cooling, instead of solid, in the ordinary way; this tends to harden the metal in the immediate vicinity of the bore and increase its tenacity. This mode of casting is principally applied to the larger calibers, from 8 to 20 inches. A gun of the latter size, weighing 116,000 pounds, throws a projectile of nearly 1,100 pounds upwards of 4½ miles at an elevation of 25°, with a maximum charge of 200 pounds powder.

The extreme length of the piece is 20 ft. 3 in.; of

bore, 17 ft. 6 in.; and greatest diameter, 5 ft. 4 in.

The Crimean war (1854) imparted quite an impulse to the improvement of ordnance and projectiles.

Lancaster's, one of the first of these, obviated rifling by making the bore elliptical, but with a gradual twist throughout, so that a projectile of corresponding shape would receive a rotary motion during its passage through the bore.

Armstrong's first gun was made in 1855, and a patent obtained in 1857. It has been extensively adopted in the British service. It is built up of layers of wrought-iron bars twisted spirally in reverse directions over a steel core, and bound together by one or more wrought-iron rings shrunk on at a white heat. A peculiar breech-loading mechanism is also used with this gun. See ARMSTRONG GUN.

In the Ames cannon, a series of compound longitudinal rings are consecutively welded to a concave breech-piece, upon a removable mandrel.

Blakeley's cannon is composed of an inner tube, which may be of *mild* steel, upon which an outer tube of less extensible material, as hard steel, is shrunk. His first English patent was in 1855. The American patent, in which the process here mentioned is described, bears date 1864.

Whitworth commenced experimenting about 1855, and his guns underwent a satisfactory test in 1860. The leading peculiarities are a bore which is hexagonal in cross section without grooves, and having a rapid twist; the projectile is a hexagonal bolt whose spiral conforms to the twist of the bore and is destitute of knobs and used without a sabot. The device for breech-loading differs from that of Armstrong.

Krupp's first steel cannon (1849) were objected to on account of their novelty and expense. He has since furnished cannon to Asia as well as Europe. He has used a mixture of steel and iron, the latter metal increasing the elasticity.

The compound was cast in plumbago crucibles, and forged while still at a red heat under an enormous steam-hammer, compressing the mass two or three per cent, and nearly doubling its tensile strength. Cannon of over 8-inch bore are made up of several concentric rings; those of a smaller size are forged solid.

Krupp's monster gun, at the Paris Exposition of 1867 (see illustration on opposite page), consists of an inner tube weighing 20 tons, upon which are shrunk cast-steel rings, forming at the breech a threefold and at the muzzle a twofold layer of metal; these are made from massive ingots without welding, weighing together 30 tons.

The total weight of the gun is 50 tons; caliber, 14 in.; total length, 17½ ft.; weight of solid shot, 1,212 pounds; weight of shell, 1,080 pounds; charge of powder, from 110 to 130 pounds. A special car weighing 24 tons was constructed for the transportation of this gun to Paris.

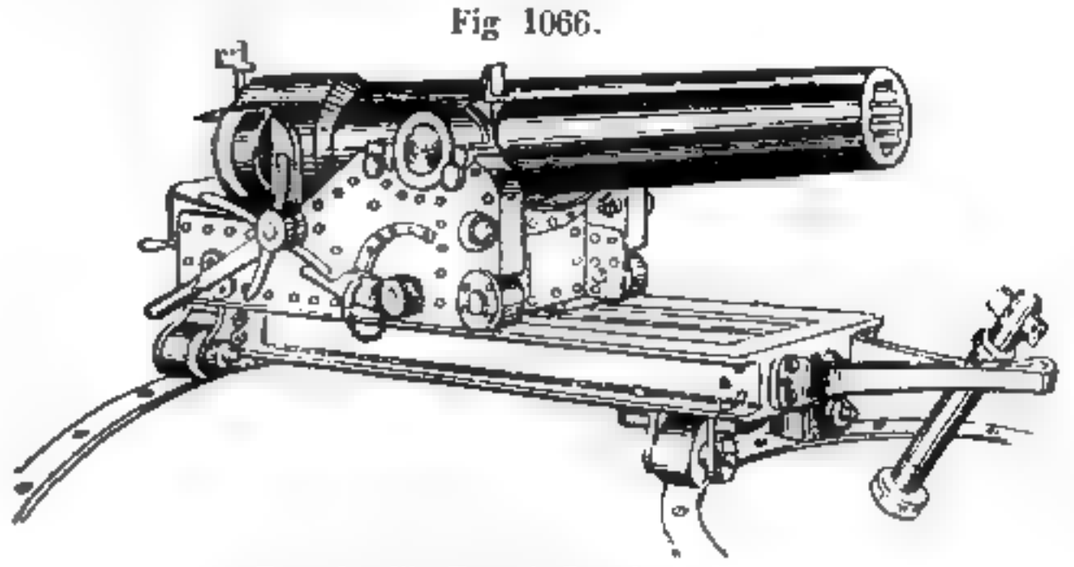
The gun is mounted on a steel carriage weighing 15 tons, supported on a center-pintle chassis weighing 25 tons.

The breech-loading is on Krupp's patent plan. The shot or shell is raised by a block and fall, and is rolled into the side of the breech through an aperture closed by a slide.

Though many breech-loading guns of this or similar construction were employed by North Germany during the late Franco-Prussian war, we know of none at all approaching it in size.

Baron Wahrendorff, of Sweden, some 30 to 40

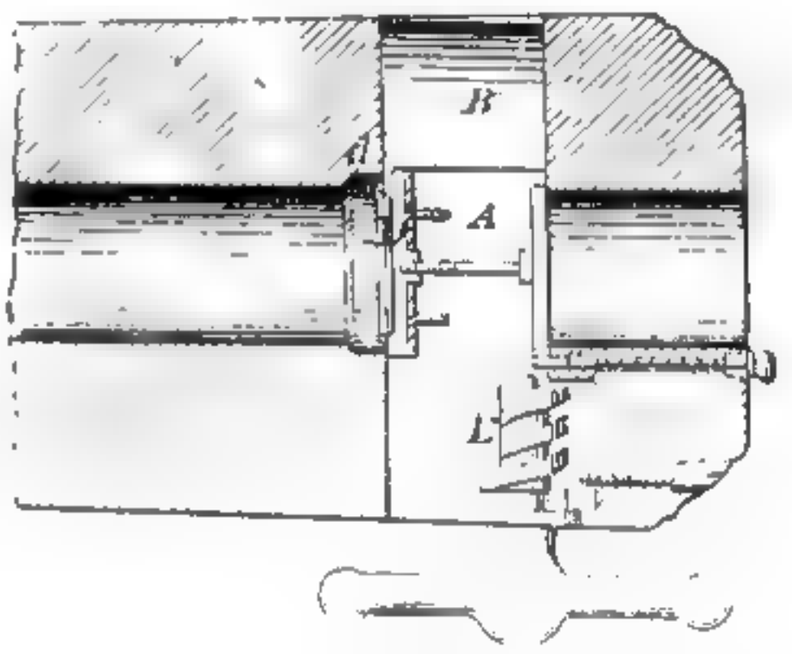
Fig. 1066.



Broadwell's Breech-Loading Gun

years ago, contrived a breech-loading cannon, in which the bore extended the whole length of the piece, the projectile being passed in at the rear and secured by a transverse breech plug and wedge. Caralli's rifled cannon of later date loaded at the breech in a nearly similar way.

Fig. 1067.



Broadwell's Breech-Block (Detail View.

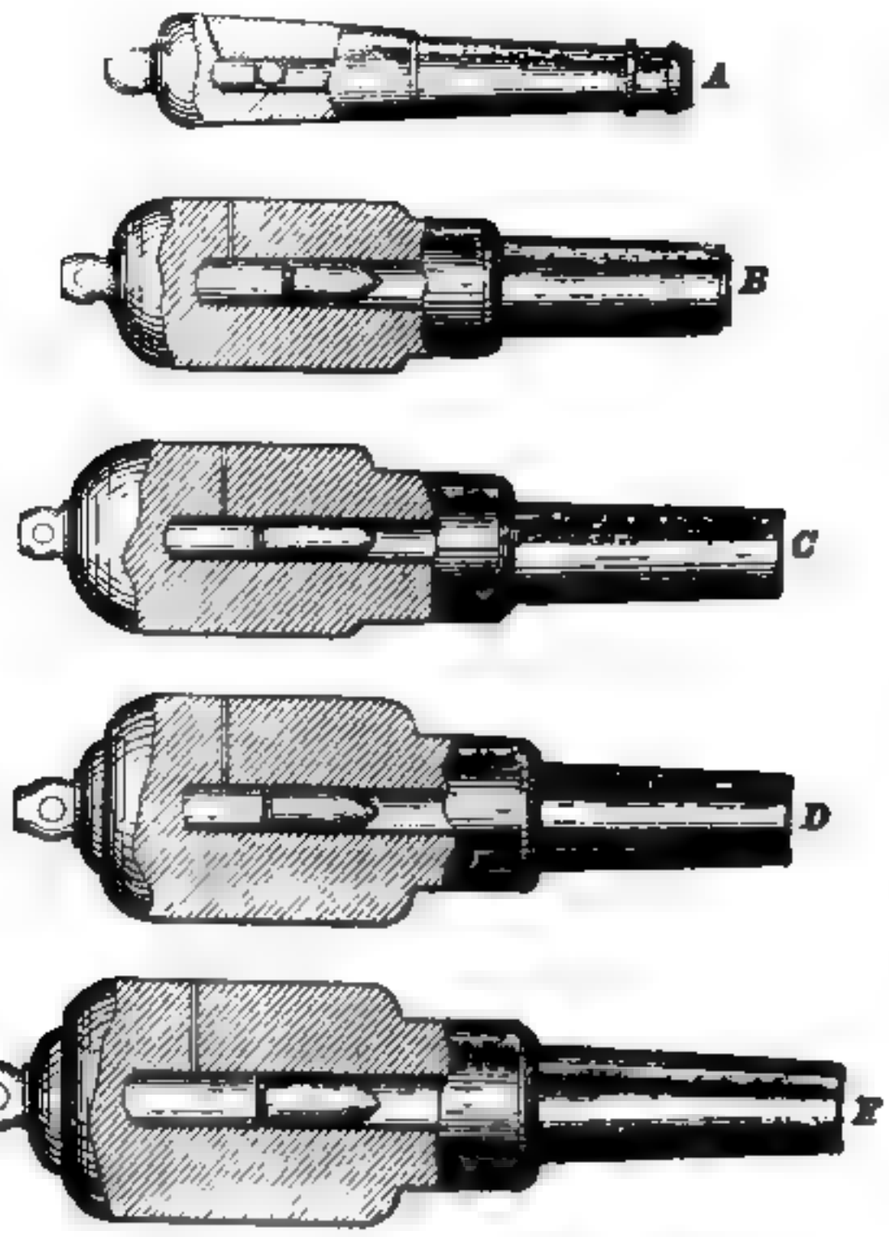
The Broadwell breech-loading cannon has a steel wedge or breech-block *A*, moving horizontally in a mortise *B*, made through the breech of the piece at right angles with the bore. This breech-block is operated by means of a partially threaded screw, *E*, located in its rear side, which finds its socket-thread in the gun behind it, and is thus locked in position at the moment of fire.

One half-turn of this screw is sufficient to loosen the block, and permit it to be easily withdrawn to the position for loading the piece.

The gas-check consists in a peculiarly curved steel ring *d*, located in a correspondingly shaped chamber in the bore of the gun immediately in front of the breech-block. When the charge is fired, this ring is expanded by the gases and pressed tightly against the walls of its chamber and also against a steel bearing plate, *H*, let into the face of the breech-block, thus forming a perfectly tight gas-check.

The armaments of the British iron-clads are of heavier and heavier guns as years go by. The annexed figure gives a comparison of the relative proportions and weights of the guns: *A*, "War-

Fig. 1068



Armaments of English Iron-Clads.

rior's" armament, — 68-pounder; 4½-ton gun. charge, 16 pounds. *B*, "Bellerophon's" armament, — 250-pounder; 12-ton gun; charge, 43 pounds. *C*, "Hercules's" armament, — 400-pounder; 18-ton gun; charge, 60 pounds. *D*, "Monarch's" armament, — 600-pounder; 25-ton gun; charge, 70 pounds. *E*, "Thunderer's" armament, — 600-pounder; 30-ton gun; charge, 100 pounds.

These figures are exceeded by the latest English gun (the 35-ton), which is by no means, however, what it is paraded as being, — the largest gun in the world.

	Pounds.
Woolwich, 35 tons 7 cwt. (English count) =	79,084
Armstrong (Big Will)	50,400
Krupp, 14-inch (1,080-pounder) . .	100,000
Rodman, smooth-bore (20-inch) . .	116,497

The "Thunderer," 4,400 tons, and the "Fury," 5,000 tons burden, are designed each to carry four of these 35-ton guns, in two turrets, two guns being placed in a turret side by side.

Among the earliest cannon made in Europe were *breech-loaders*, specimens of which are preserved in the Artillery Museum of Woolwich, England.

The charge was inserted in an iron cylinder, which was fixed by wedges in its place in the breech of the gun.

Breech-loading cannon were introduced by Daniel Spekle, who died in 1589, and by Uffanus.

Cannon of ice were made at St. Petersburg in 1740, and repeatedly fired, — a whim.

All the rifled cannon in the British service of less than 6 3-inch caliber are breech-loaders.

At the siege of Badajoz, the firing was continued for 104 hours, and the number of rounds fired from each 24-pounder iron gun averaged 1,249; at the siege of St. Sebastian each piece was fired about 350 times in 15½ hours. But few of these pieces were rendered unserviceable; but it is estimated that three times the number of brass guns would have been required to produce the same effect, or maintain such long and rapid firing.

An experimental Armstrong 32-pounder, weighing 26 cwt., with a charge of 6 pounds and an elevation of 33°, sent its projectile 9,153 yards. The range was carefully measured. Mr. Whitworth states that his little 3-pounder, fired at Southport, attained a range of 9,688 yards. The long experimental 7-inch gun of six tons, designed by Mr. Lynall Thomas, with 25 pounds of powder, propelling a shot of 175 pounds, and fired with an elevation of 37½°, ranged 10,075 yards. There have been several other instances of long ranges, and there would be more but for the general uselessness of firing at distances where no aim can possibly be taken.

The accelerating principle has been again and again suggested, and consists in increasing the velocity of the projectile by the ignition of successive charges of powder during the passage of the ball through the bore. Henry Bessemer, and Captain Fitzmaurice of the British navy, are yet inventing and confident. The former designs a tube 60 feet long, with charges 60 in number, fired by electricity in quick succession, so that each may exert its force before the ball escapes at the muzzle.

Moncreiff's plan for mounting ordnance is to make the recoil of the gun in firing swing the gun backward and downward, so as to depress it below the sill of the embrasure and allow the gunners to load it without exposure to the enemy.

Various modes of mounting and operating guns have been devised for monitor and turret use, for which consult patents of Eads and Ericsson. Very ingenious indeed are many of these devices.

2. (*Machinery.*) A metallic hub or sleeve, fitted to revolve on a shaft or with it.

Can'non-cast'ing. The molds for brass cannon are formed by wrapping a long taper rod of wood with a peculiar soft rope, over which is applied a coating of loam, which, as the work proceeds, is dried over a long fire, a templet being applied to form the proper outline. This model is made about one third longer than the gun is to be. It is next, when dry, blackwashed, and covered with a shell of loam not less than three inches thick, secured by iron bands, which is also carefully dried. The model is next removed by withdrawing the taper rod and the rope, and extracting the pieces of loam. The parts for the cascabel and trunnions are formed upon wooden models, and then attached to the exterior of the shell; handles, dolphins, or ornamental figures, are modeled in wax, and placed on the clay model previous to molding the shell, from which they are melted out before casting.

When dry, the shells are placed muzzle upward in a pit in front of the furnace or furnaces, and the earth thrown in and well rammed around them. At the same time, a vertical runner, which enters the mold near the bottom, or not higher than the trunnions, is made for each mold, terminating in a trough or gutter, at the far end of which is a square hole to receive any excess of metal. The runners are stopped by iron bars, which are successively withdrawn as the preceding mold in order becomes filled, and the furnace or furnaces are tapped by an iron bar with a

taper end, so as to regulate the flow of metal, by making a larger or smaller orifice, as required. A spade or gate across the gutter at a certain point prevents the metal from flowing beyond this till the molds towards that end are filled, and when the last is removed the metal is allowed to flow into the square pit before referred to.

The general process with iron cannon is very similar. In all such large castings a large head or sprue must be allowed to maintain a pressure adequate to produce a sufficient solidification at the breech, where the metal should be strongest.

In casting the first 20-inch gun at Fort Pitt Foundry, in 1864, the mold was in four pieces; the core was on the Rodman plan, a fluted cylinder of cast-iron, circular or semi-elliptical at the lower end, and closed at top by a cap through which a pipe enters, conducting water to the bottom, from which it rises to near the top, and is carried off by a waste-pipe.

Five furnaces, charged in all with 105 tons of metal, were employed, — two containing 23 tons, one 39, and the two smaller between 5 and 10 tons each. The molten metal was admitted to the bottom of the mold through two gates, one on each side. Six hours were required for its complete fusion, which was maintained for one hour twenty-four minutes, when the large furnaces were tapped, filling the mold in twenty-two minutes. So long as a constant flow of water was admitted to the core, the temperature of that issuing from the discharge-pipe did not exceed 92° F., falling within twenty-one hours to 57°; but when the flow was stopped, the temperature rose to the boiling-point.

Car'bine. A small arm with a short barrel, adapted for the use of cavalry, and having a bore of .44 or .50 inch, or thereabout.

They appear to have come into notice in the army of Henry II. of France, 1559. The arm was 3½ feet long, and the practice was to fire and fall back behind the rear rank, who fired and followed suit. The troops were light cavalry, and the arm seems to have had a wheel-lock.

The term now is applied to a short gun adapted for cavalry, of which many breech-loading varieties have been tried in the United States army with greater or less success. Previous to the general introduction of breech-loaders, the fire-arm in common use for cavalry, as well as engineers and heavy artillery, was a species of carbine denominated musketoon, differing from the musket only in length and in the fact that the arm for the cavalry was provided with a sling-bar for more convenient carriage on horseback; those for the engineers and artillery were generally furnished with sword-bayonets. These all appear to have corresponded nearly in caliber and general dimensions with the modern French *carabine*.

The *Spencer* rifle was extensively used by the cavalry of the Union army during the late war.

Car'bo-az'o-tine. An explosive:—

Nitrate of potassium	61.04
Sulphate of iron	0.73
Lampblack	24.65
Sulphur	13.58
	100.00

Car'tridge. A "round" of ammunition, including the ball with the sabot, if any, and its projecting charge, enveloped in a single case.

This is a modern institution, it having been originally customary to employ loose powder and ball.

Then followed a cartridge containing a measured quantity of powder, the bullets being carried separately in a bag. The end of the paper cylinder was bitten off and the paper used as a wad. Gustavus Adolphus (killed at Lutzen, 1632) is said to have been the first to have made up the cartridge with a measured quantity of powder and a ball fastened thereto.

Sir James Turner, in the time of Charles II. of England, speaks of cartridges employed by horsemen, carried in a "patron" which answered to the modern cartridge-box. After this time it appears that cartridges were carried in cases suspended from *bandoliers*, equivalent to the more modern bayonet scabbard-belt.

Soon afterward the great improvement — the cartridge-box — was adopted, which still, under various modifications, continues in use. See ACCOUTERMENTS.

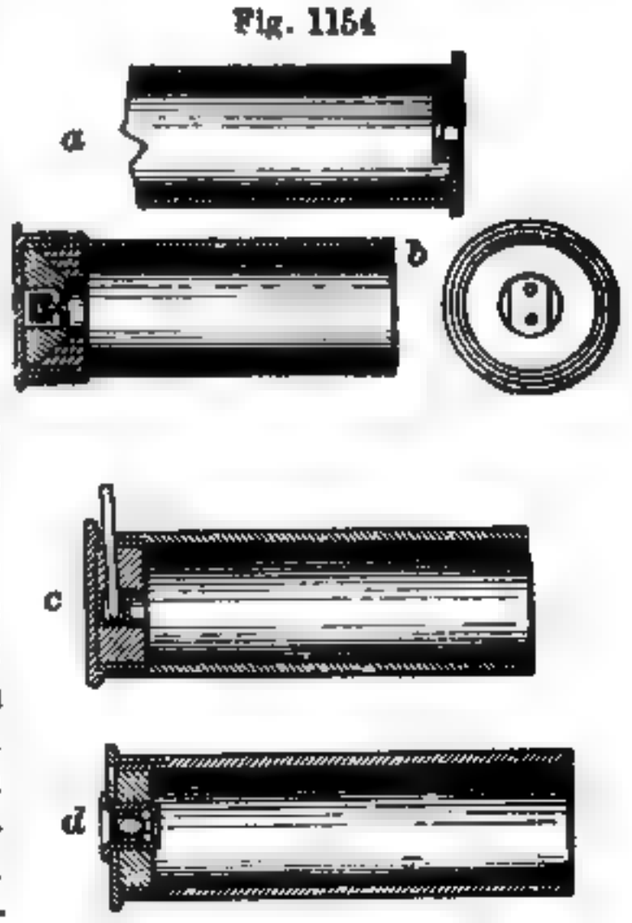
Plain, round ball, and buck and ball cartridges

Fig. 1153.

Cartridges.

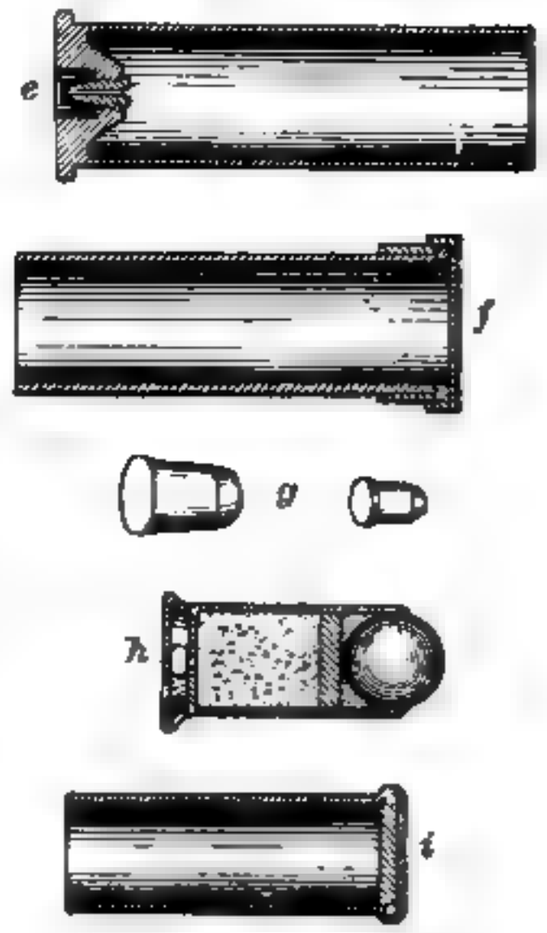
are now practically obsolete. These were formed of a paper cylinder, which was partially filled with powder and choked near its mid-length by twine, the powder occupying one end and the ball the other. Other substances than paper, as animal intestines prepared in a peculiar way, were sometimes employed. Colt covered his cartridges with tin-foil, and afterwards a paper saturated with nitrate of potassa was introduced. This might be placed in the gun as it was, the covering facilitating, rather than retarding, the ignition of the powder. In Fig. 1153, *a* is a *buck and ball* cartridge, *b* one having buckshot only, *c* the Prussian needle-gun cartridge (see FIRE-ARM). In this the bullet *B* has a sabot *A*, separating it from the powder *D*, and having at its base a cavity *C*, for the reception of fulminate. The case of this cartridge is made of

Fig. 1154



paper.

d, Snider's, for the muzzle-loading Enfield rifle converted into breech-loading (see FIRE-ARM), is made up of a sheet-brass cylinder *A*, into which is inserted the bullet *B*, having at its base a recess *E*, which contains a plug of clay. Back of this is the powder-chamber, having at its base a sabot *G*, into a cavity of which fulminate is inserted and exploded through the action of the firing-plunger on a cap *C*.



Metallic Cartridge-Cases.

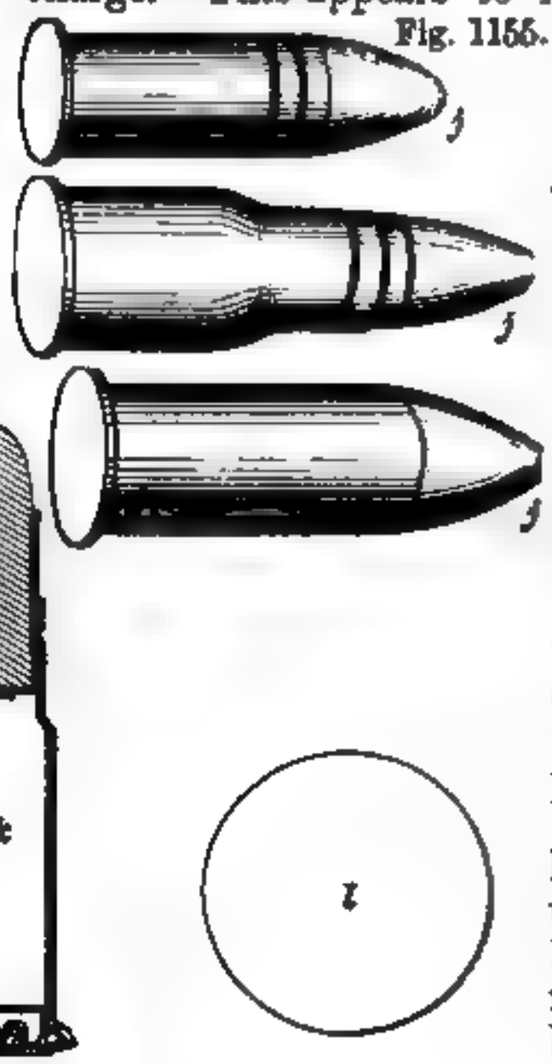
It may be remarked that the American process of drawing out the blanks for metallic cartridge-cases into tubes is now generally adopted into the European services.

This style of cartridges is divided into two classes — *rim* fire and *center* fire, — the first having the fulminate arranged within a cavity around the interior of the flange, and the latter having it arranged at the center of the head or base of the cartridge. Each kind requires the hammer or firing-pin of the gun to be specially arranged, in order to strike the cartridge at the proper point, though cartridges have been devised in the United States to be both *rim* and *center* fire, and guns have also been made to fire either or both kinds of cartridges.

The idea of using sheet metal for this purpose seems to have originated with the French.

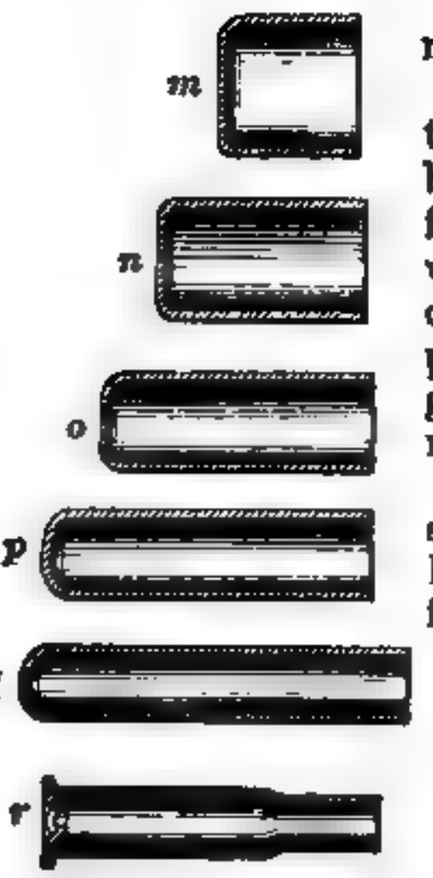
In 1826, Cazalat patented a cartridge of this kind (*a*, Fig. 1154), having a receptacle with a covering patch of water-proof paper for fulminate at its base. A hole in the bottom of the cup admitted fire to the charge. This appears to have been in advance of the age, being drawn from a single piece of copper, and being *center-fire*. *b* and *c* represent two forms of the Lefaucheux cartridge, — one of the earliest of this kind. In *b*, the cap is secured to an anvil-block; in *c*, a plunger, struck by the hammer, explodes a fulminate placed in a chamber at the base.

Fig. 1155.



d, *e*, show modifications of this, the anvil and cap principle, in which the pin is dispensed with.

f. One of the earliest-known cartridges is that of Roberts, of Paris, 1834, in which an annulus was formed at the base to contain fulminate.



Metallic Cartridges.

g is the Flobert cartridge, in which is a ball with a charge of fulminate at the base, which does the duty at once of priming and propelling, adapted for target-practice at short ranges.

h, *i*, Smith and Wesson patents, 1854, 1860. In the first of these the fulminate was contained in a capsule at the base, and in the latter in an annulus within the flange surrounding the base of the cartridge, and secured in place by a pasteboard disk.

j, *j*, *j*, show some other forms of metallic cartridge as now commonly used.

k is the Berdan cartridge; this has an exterior central recess, a bottom to receive the cap, which is exploded upon an anvil turned up on an interior metallic lining. The case is adapted to fit a chamber larger in diameter than the bore of the barrel.

The mode now generally adopted for forming metallic cartridges is to punch the blank out from a sheet of brass, and to draw it between successive rolls and punches until it assumes the required shape. The shape which the cartridge-case assumes during the different stages of the process is shown in the figures *l* to *r*.

Cannon-cartridges for 6 and 12 pounder smooth-bored field-guns, the former of which may now be considered obsolete, have the powder-charge, contained in a woolen or silken bag, and the projectile united together by twine. For larger smooth-bored and all rifled guns, the powder is put up in a separate bag, still, however, retaining the name of cartridge.

Car'tridge. (*Fire-arm.*) A loaded capsule or case. The case is made of paper or metal; the former, until of late years; now almost universally of metal, — copper or brass.

Cases are *cylindrical* or *bottle-nosed*: in the latter, the portion containing the powder is one or two bores larger than the actual bore of the piece, the chamber being reamed out for that purpose. By this means a shorter case may be used and the proper charge of powder retained.

In cartridge-making 18 different machines are used: 8 to form the case, 3 for the bullet, 5 to make the anvil or cap, and 2 for loading the cartridge.

The first process is called *cupping*, which is done with a die working inside a cutter. A sheet of copper 3/" wide is fed under the cutter by the attendant and a circular blank 1¼" in diameter is cut, and then pushed through a flaring-mouthed die by the punch, thus making it into a cup-shape about 1" in diameter and ¼" deep.

In the next machine, called the *first draw*, the cup is fed over the die by the revolving plate and an automatic movement, which takes one at a time off the plate and places it over the die, which is somewhat smaller than the one in the cupping machine. It is then pushed through by the punch. It passes subsequently through four more *drawing machines*, each one making it longer and narrower, until it becomes 2" long and ¼" in diameter. After the third *draw* it is annealed, having become hard by working.

After passing through the fifth draw it is put in the *trimming machine*, and the edge made even by a revolving cutter which reduces it to a certain size.

The capsule is next put into a machine called the *header*, which spreads the closed end into a head by pressing it into a mold.

The ninth process, *anvil-cupping*, is the same as the first, except that it produces a cup about $\frac{1}{8}$" diameter and $\frac{1}{16}$" deep for the cup to hold the fulminate. The anvil is then trimmed in another machine; in the next, called a *venting machine*, two small holes are punched in the head to afford passage for the fire of the fulminate to reach the charge. It next has an impression made in the outside of the head for the wafer of fulminate, and is next put in the *priming machine*, where it receives the fulminate. The practice with *central* fire and *rim*-fire cartridges diverges at this point, in the latter case the fulminate is secured by crimping the case from the outside, the same machine tapering the open end of the case to receive the bullet.

The bullets are made by a machine which cuts about 1" from a rod of rolled lead $\frac{1}{4}$" in diameter, and presses the leaden blank in a mold, which gives the shape and makes the three circumferential grooves. The next machine trims the bullets, which then pass through the *lubricator* which fills the grooves with Japanese wax, the object of which is to keep the barrel of the gun lubricated.

The last machine is the *cartridge loader*: the cases come successively under a powder reservoir where a charge of 72 grains is dropped into each, after which the bullet is put in, and the shell pressed around it to hold it firmly.

The following is a list of the machines included in the exhibit of the War Department at the Centennial Exhibition, 1876, under the orders of Lieutenant Metcalfe, in the Government Building; several machines are practically duplicated, as the successive drawing machines for instance: —

Cupping machine.	Priming machine.
Anvil cupper.	Loading machine.
Lubricator.	Drawing machine.
Case trimmer	Clamp-milling machine.
Impression machine.	Bullet machine.
Butt lathe.	Heading machine.
Barrel-boring machine.	Milling machine.
Barrel-turning lathe.	Rifling machine.
Straightening machine.	Bedding machine.
Tapering machine.	

See account in "*Scientific American Sup.*," • 869

Norton's report on "*American Breech-loading Fire Arms*," N. Y., containing a description of the following cartridges: —

Boxer, British, central fire.
Daw, British, central fire.
Chassepot, French.
Zundnadelgewehr, German.
Meigs.
U. S. Cartridge Co.

See report on "Performance of Metallic Cartridges," at Frankfort Arsenal, Penn., by Major Treadwell, U. S. Army, 1873. Notices and illustrations are given of the following (• illustrated): —

Burnside . . .	• 1860.
Maynard . . .	• 1860.
Spencer . . .	• 1864, rim primed.
Primitive . . .	• 1864.
Laidley . . .	• 1865.
Novelty . .	• 1866, center primed.
Bar-anvil . .	• 1866.
Gatling . . .	• 1865.
Canister . . .	•
Benton . . .	• 1867, cup reinforce.
Tubal . . .	• 1869.
Benet . . .	• 1868, cup anvil
Service . . .	• 1868, blank cartridge.
Benet . . .	• 1866, center-primed.
Crispin . . .	• 1867, combination: paper and metal.
Colt . . .	• 1868.
Martin . . .	• 1869.
Corliss . . .	• Front ignition.
Prince . . .	• Front ignition.
Milbank . . .	• 1870, reloading
Milbank, et al . .	• Primer
Reinforced . . .	•
Frankford . . .	• Gas check.
	• Attached head.
Rodman-Crispin	• 1863, wrapped metal.
Boxer-Henry .	• 1872, wrapped metal.
Frankford . . .	• 1872, cast base.
Hotchkiss . . .	• 1868, solid head.
Benet . . .	• 1868, solid head.
U. S. Cartridge Co.	• 1868, solid head.
Dutch musket	• Reloading shells.
Dutch carbine .	• Reloading shells.
Farrington . . .	• Solid head.
Navy	• Front lubrication.
Frankford . . .	• 1865.

See report of Major Bell to Colonel Craig, Chief of Ordnance, May 16, 1856, on the firing of Dr Maynard's breech-loading rifle charged with a metallic cylindrical water-proof cartridge.

Cartridge, *Tyler*	• "*Scientific American*," xli. 246
Making	• "*Sc. American Sup.*," 2670.
Center fire, *Saget* . . .	• "*Scientific American*," xliii. 86.
Cartridge shot, *Schieber* .	• "*Scientific American*," xl. 212.

The Russian small arm cartridge factory near St. Petersburg is described in "*Ordnance Report*," 1877, pp. 519 *et seq.*

Car'tridge Block. A wooden block, bored to receive 8 cartridges, and having attachments by which it is secured to the gun in convenient position for loading. It is shown in Fig. 552 as attached to a *Peabody-Martini* military rifle.

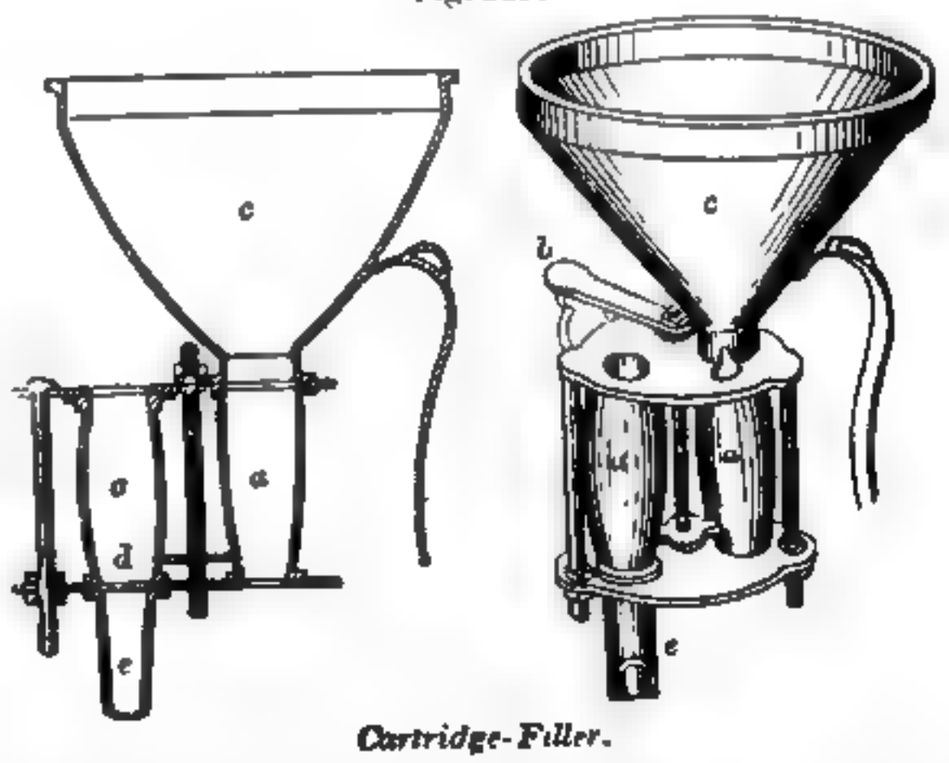
Car'tridge Cap'per. An instrument for securing caps on central fire cartridge-cases. The pivoted lever has a stud beneath, which presses the cap firmly upon its seat. Fig. 551.

Fig 551

Parker Bro.s Cartridge Capper.

Car'tridge Fill'er. A device for charging cartridge-

Fig. 1158



Cartridge-Filler.

cases with the proper quantity of powder. In that shown, the two filling-tubes *a a* are partially rotated by the lever *b*, so as to bring each of them alternately under the funnel *c*, and over the discharge-aperture *d*; while one is being filled, the other is discharging its contents into a cartridge-case through the pipe *e*.

Car'tridge-head'ing Machine'. A machine for forming the head

or rim of a cartridge case. It consists of a horizontal die, countersunk at one end for shaping the head; a feed punch, to insert the tubes into the die; and a heading punch, to flatten the closed ends of the tubes into the countersink.

The tubes, which are a little longer than the completed cases, are fed into the inclined trough of the machine, whence they are taken up on the feed-punch. A shoulder on this punch, at a distance from its extremity equal to the inner depth of the headed case, prevents it from penetrating to the full depth of the tube, and a surplus of metal is thereby left at the closed end of the tube for the formation of the head.

Car'tridge-head Test'er. A hydrostatic press invented by Col. Treadwell, U. S. Army, for testing strength of cartridge heads.

Plate XXIII., Ordnance Report, U. S. Army, "*Metallic Cartridges*," 1872.
Plate XXIV. *et seq.* of the same, show the powder test by eprouvette.

Car'tridge Load'ing Ma-chine'. 1. A machine for loading powder and bullet into a cartridge case.

It consists of a revolving circular plate with holes, and a hopper and powder measure.

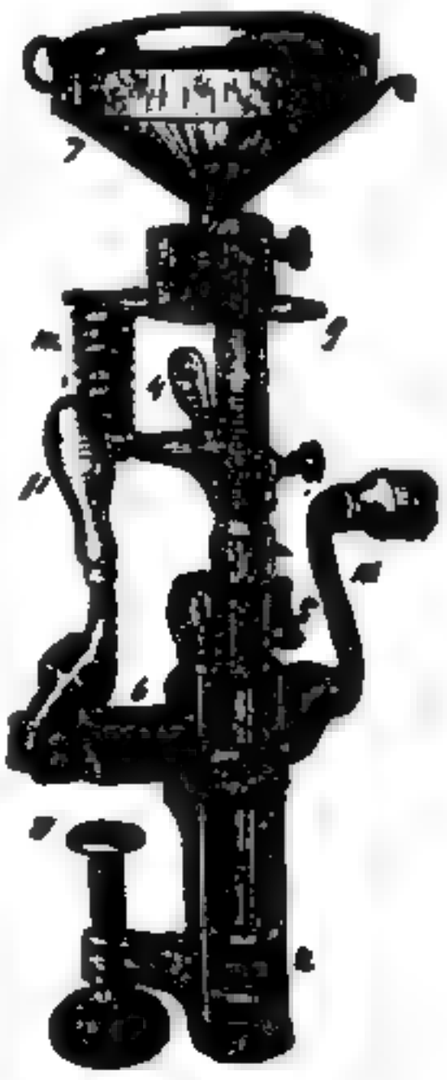
The powder is placed in a brass hopper above the machine, and is fed to the cases through a paper tube; the whole inside of a conical shield of boiler iron.

The cases and bullets are fed on revolving plates: the former lifted into the receivers, passed under the hopper and measure for a charge of powder, and then under the bullet-feeder to receive a lubricated bullet. The edge of the case is crimped on the bullet by lifting the former into a contracted space of the receiver around the neck of the bullet.

A bell indicates any failure in the supply of a full charge of powder, and the rate is 35 per minute.

2. On a smaller scale, a machine for reloading cartridge shells.

Fig. 553.



The machine is clamped to a table, leaving the crimper crank 10 free to turn. The reservoir 7 being furnished with powder, the charger 9 is set to the number of drams required. Hold the shell under the aperture of 12 in the lower shelf of charger, and dump the powder therein. Having loaded the shells with powder, remove the funnel and release the rammer; put the shell in the receiver 2, place the wad on the powder and ram home. Fill the reservoir with shot, set the charger at the gage desired, drop the charge, place a wad on the shot and ram as before; or crimp the shell, placing it in the cradle 5, and rotating the revolving hub by the crank 10. The shell may be shortened before crimping by placing it on 5 and rotating it while the knife 4 is pressed upon it.

Webb's Cartridge Loader.

Car'tridge-pa'per. A strong paper of which cartridges are made. It is of various sizes and thicknesses, according to the kind of cartridge to be made, ranging from a quality similar to bank-note paper, employed for small-arm cartridges, to that used for cannon cartridges, which is about the thickness of thin pasteboard, but rougher and more flexible. The latter is, however, now seldom or never used. The different qualities are in the United States service numbered from 1 to 6, the latter being the coarsest and thickest.

Car'tridge-prim'ing Ma-chine'. A machine by which the fulminate is placed in the copper-capsule of the metallic cartridge. The fulminate is differently disposed for center-fire and for rim-fire cartridges; in the latter the cartridge-case is rotated on its longitudinal axis, to dispose by the centrifugal action the fulminate at and about the flange.

Car'tridge-re-tract'or. That part of a breech-loading fire-arm which catches the empty cartridge-capsule by its flange, and draws it rearwardly from the bore of the gun.

Car'tridge Scales. A machine for automatically verifying the weight of cartridges; invented by *Gootkoffsky*, of the ordnance works, St. Petersburg, Russia.

"The scales are composed of eight balances, slung to the tyre of a small fly-wheel which is brought into action by the main shafting. The cartridges placed by the workmen in the box are caught up by the scales themselves and are placed in the balances. The cartridges are equipoised by a reacting weight placed on the opposite ends of the balances; on the farther rotation of the fly-wheel, the balance gradually comes to an equilibrium, upon which the cartridges of a normal weight, and heavier than the normal weight are declined along with the outer end of balance downward, and are thus pushed off by the scales themselves into the receiver, from whence they fall into a box placed on the floor. The cartridges which are of less than the normal weight, are raised upward and are thrown off by the scales themselves into another receiver, from whence they fall into a locked-up box. The fly-wheel with the balances makes 7½ revolutions per minute, that is, performs 8,600 weighings per hour, or 80,000 per day, allowing for subsidiary work and chance stoppages."

Car'tridge Var'nish-ing Ma-chine'. A machine to coat the interior of metallic rifle shells with an impermeable elastic varnish, to prevent chemical action between the salts of the gunpowder and the material of the shells.

The shells are placed in a hopper, several hundreds at a time, and fed singly into a wheel, with which they revolve, while they are also rotated in the chucks which hold them; this in order to spread the varnish. Forty of them are in different stages of the process at the same time, and the work is done at the rate of 2,000 per hour. The machine is perfectly automatic. The shells are subsequently dried in a sheet-iron furnace.

Case-shot. *Case-shot*, or *shrapnel*, as they are frequently termed, from the name of the English officer by whom they were introduced, about 1803, are a thin species of shell filled with bullets, and having a fuse which is so cut or arranged as to burst the case about sixty yards in front of the object fired at, so as to scatter the bullets over a considerable space. This, under favorable circumstances, is a very efficient projectile, and would be still more so were it possible to cut the fuse to such exactness as to always explode just at the desired point. The shot are sometimes placed in a tin cylinder with a wooden sabot, and used without a fuse at ranges of

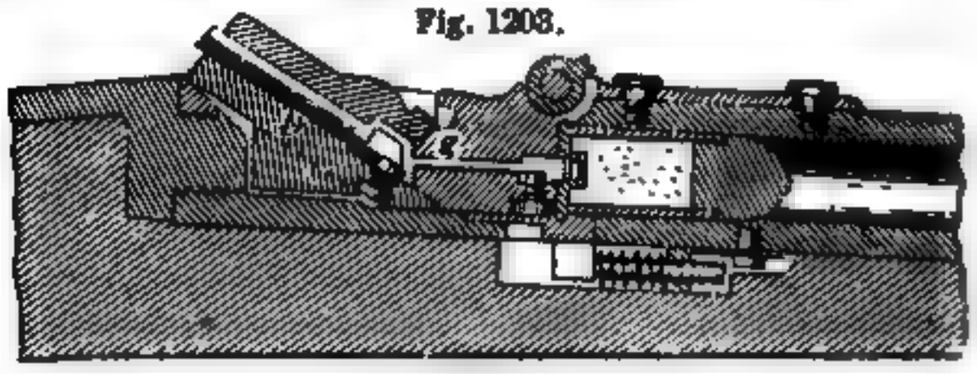
300 yards. This is distinctively known as *canister*.

Case Trim'mer. *(Cartridges.)* An implement or machine, one or the other, used for trimming the mouths of shells for cartridges. These are fed by a funnel to the tool, which has a knife to cut them to an adjusted length.

Cen'ter-fire Car'tridge. One in which the fulminate occupies an axial position, instead of being around the periphery of the flanged capsule.

In the illustration the fulminate is in a cap, and

Fig. 1203.

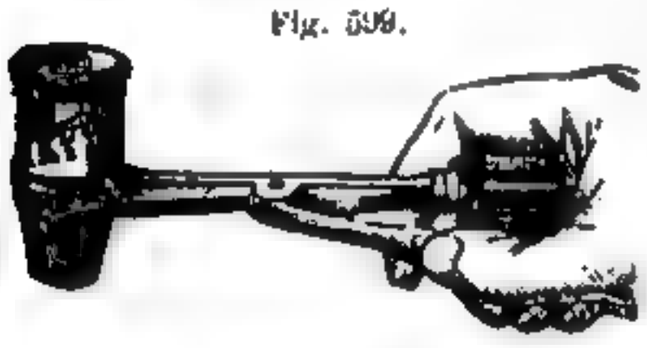


Center-Fire Cartridge.

is struck by a firing-pin *g*, when the hammer descends upon the end of the bolt *D*. See CARTRIDGE.

Char'ger. An instrument for measuring powder and shot, and loading into a fowling-piece. One is shown at Fig. 1250, p. 528, "*Mech. Dict.*"

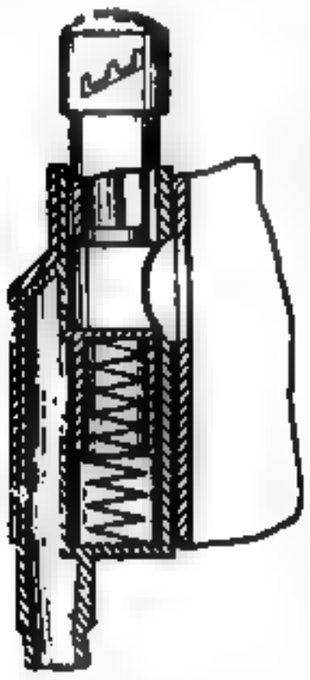
Fig. 599.



Dougall Charger.

Dougall's charger is a dipper, graduatable by slide for quantity, and discharging the contents into the gun by pressing the lever with the thumb.

Fig. 1250



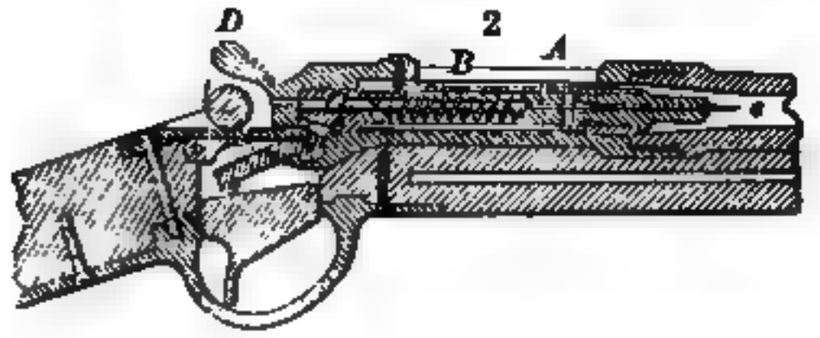
Gun-Charger.

Char'ger. 1. *(Mining.)* A spiral instrument for charging horizontal blast-holes.

2. A device for dropping into the bore of a fowling-piece from a shot-belt or pouch a gaged quantity of shot. By forcing down the plunger the communication with the pouch is closed, and the charge is allowed to pass to the tube, which conducts it to the gun. The piston-head is adjustable, to vary the capacity of the charge-chamber.

Chasse'pot-gun. The breech-loading, center-fire needle-gun of the French service. It was designed as an improvement on the Prussian needle-gun, or *zündnadelgewehr*, to which it was opposed in the

Fig. 1258.



Chassepot Rifle.

Franco-Prussian war of 1871, and derives its name from the inventor. A paper cartridge is employed in the gun as originally constructed in 1867, but in 1869 M. Chassepot patented an improved arrangement, embracing a cartridge-retractor for use with a central-fire metallic cartridge; the construction of the gun is, however, essentially the same.

An opening on the right of the chamber *A* permits the insertion of the cartridge, which is effected by resting the butt of the gun, held in the left hand, against the left hip, turning the lever *c* from right to left and drawing it back, thus retracting the hollow cylinder or breech-block *B*; the cartridge is placed in the opening thus made, and is pushed home to its seat by a forward movement of the lever, which is then turned back to its original position, locking the breech-block in place. The shaft *C*, contained within the cylinder *B*, carries the needle *e*, and is drawn back by means of the knob *D*, compressing the spring which surrounds the shaft, until a detent thereon engages with the tumbler of the lock, holding the latter in cocked position. Pressure on the trigger allows the spring to act, driving the needle forward, penetrating the cartridge, and exploding the fulminate. A rubber washer at the inner end of the cylinder *B*, through which the needle passes, acts as a gas-check.

Check'ing. Engraved cross-hatching on certain parts of a rifle, gun or pistol stock, to increase the security of grip in handling.

Checking machines are used in armories for cross-hatching the swivel keys of rifles, etc.

Chi-nese'-fire. A pyrotechnic composition consisting of gunpowder, 16; niter, 8; charcoal, 3; sulphur, 5; cast-iron borings (small), 10.

Chron'o-scope. Invented by Professor Wheatstone in 1840, to measure small intervals of time. It has been applied to ascertaining the velocity of projectiles. In Pouillet's chronoscope, a galvanic current of very short duration makes a magnetic-needle deviate, the duration of the current being measured by the amount of deviation; by this means as short a time as some thousandths of a second can be measured. Schutz's chronoscope was employed by the Ordnance Department at the experimental firings at Fortress Monroe. The apparatus, operated by electricity, is described as follows:—Two wire targets are placed, one about twenty yards from the gun, and the second about the same distance farther on. These are connected by a fine insulated wire with the instrument, which is about 400 yards in the rear of the ordnance. The

instrument is adjusted on a plan similar to an electro-ballistic machine. When the shot is fired, it cuts the wire in the first target, and then in like manner cuts the wire in the second target, the instant each wire is severed being recorded by the instrument. The interval of time occupied by the ball in passing from one target to the other furnishes the data for obtaining the initial velocity of the shot.

Noble's chronoscope is used for measuring the velocity of the shot during its passage through the gun. The ball presses upon a series of disks which in moving break or make electric connections, which are recorded on a rapidly rotating disk which has a known rate.

Clov'er Leaf Sight. A rear gun-sight having side holes, which slightly resemble two foils of the clover leaf

Fig. 668 *Clover Leaf Sight*

Colt's Pis'tol. A revolving pistol first patented by Colt in 1835, and perfected in 1845. See REVOLVER.

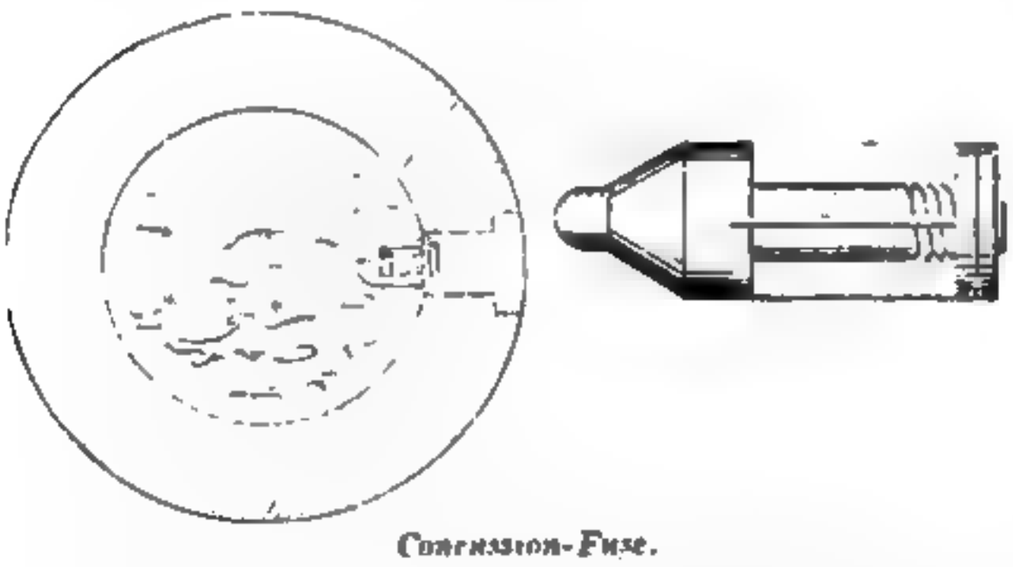
Com'bi-na'tion Open and Peep Sights. A species of gun-sight, Fig. 669, having several sights for different distances. When the leaf is down, a low slit-sight is exposed. When the leaf is lifted, the peep sight may be slipped up and down on the graduated stem, according to the distance of the object.

Fig. 669.

Combination Open Peep Sight

Con-cus'sion-fuse. A fuse which is ignited and explodes the shell at the moment of impact, by the breakage of a capsule or other similar internal arrangement, containing chemicals which explode

Fig. 1413



Concussion-Fuse.

by the force of the blow. The figure shows a spherical and an elongated projectile provided with a fuse which is exploded by the jar of impact.

Con-ver'sion. Changing the bore or fitting of a gun, as —

1. The conversion of a smooth bore to a rifle.
2. A muzzle-loader to a breech-loader.

A report on the fabrication of wrought-iron tubes at the West Point foundry for conversion of Rodman 10″ smooth-bore guns into 8″ rifles, is contained in the "*Report of Chief of Ordnance, U. S. A.*," 1877, iii., pp. 400–412, and Plates I.–VII. accompanying.

Small arms, French system, *Tabatière*, *Ibid.*, App. I., Fig. 91.

Small arms, English system, *Snider*, *Ibid.*, App. I., Fig. 92.

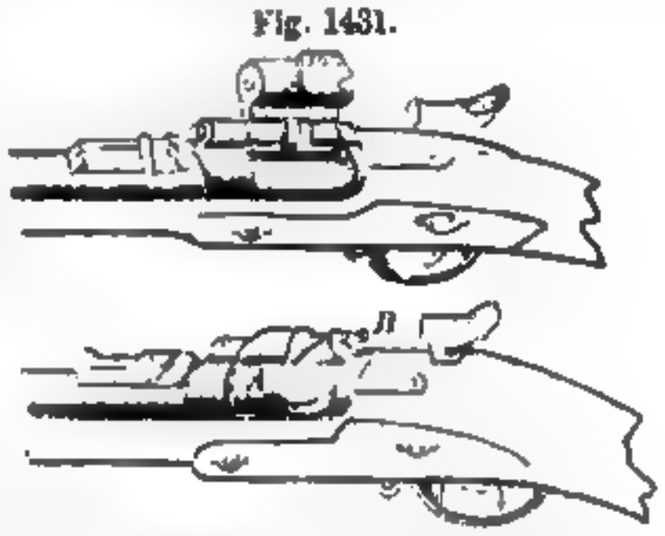
10″ smooth-bores into 8″ and 9″ rifles, *Ibid.*, 1876, App. II, p. 55.

15″ smooth-bores into 11″ muzzle loading rifle, *Ibid.*, 1879, Appendix II, p. 61.

Con-vert'ing. 1. (*Fire-arms.*) A name applied to changing muzzle-loading arms to breech-loaders, and which, in some form, has taken place with the small-arms of most national armaments.

From among the various competing plans for converting the Enfield rifle of the English service into a breech-loader, that of Snider was adopted. The cost of conversion is about 15*s.* English for each rifle.

Fig. 1431.



Snider's Converted Enfield Rifle.

The method is as follows:

About two inches of the barrel are cut away at the breech, and a solid breech-stopper *A*, working sideways on a hinge, is placed in the opening thus made. Through this stopper passes a piston, one end of which, *B*, when the breech is closed, receives the blow from the hammer, while the other communicates it to the center of the cartridge, thus firing the latter. The empty cartridge-case is retracted after each discharge by means of sliding back the stopper on its pintle, when the tilting of the piece tips out the shell and another can be inserted. It weighs 9 pounds 5¼ ounces, and has been fired fifteen times in a minute.

The Springfield (U. S.) rifle is also *converted* into a breech-loader. See FIRE-ARM.

Coun'ter-sink. 1. (*Fire-arms.*) The recess in the rear of the chamber in which the rim of the cartridge fits.

Cov'ered Sight. (*Fire-arms.*) One having the sight inclosed in a ring or tube. See BAR AND BEAD SIGHT; BEACH COMBINATION SIGHT; GLOBE SIGHT, etc.

Cross-bow. A weapon formed of a bow crosswise upon a stock. It is similar in kind to, but smaller than, the ballista, which it doubtless suggested. It was used by the Normans at the battle of Hastings. The *arbalest* was a form of it.

Crush'er Gage. A registering instrument exposed in the bore of a gun to measure the pressure developed by the explosion of a charge. See PIEZOMETER; CUTTER.

To illustrate: a 16-ton steel gun of Varasseur, fired at Woolwich, had a projectile of 400 pounds, 70 pounds of pebble powder made up into a cartridge 25″ long. The charge being fired at the center, the crusher gage at the rear of the charge showed a pressure of 21 tons to the square inch, the gage at the base of the shot, 18 tons; initial velocity of the shot 1412′ per second. The charge fired at the base, the gage gave pressures of 45.1 and 50.1 tons respectively at the rear of the charge and base of the shot.

Cup'ping Ma-chine'. (*Cartridge.*) The first machine in bullet-making. It has two stamps or dies, one working inside the other; the outer one

cuts the blank out of a sheet of copper, and the next draws it into a cup-shape, making it ready for subsequent draw-

Cut'ter. 1. (*Ordnance.*) An instrument for determining the pressure per square inch exerted within the bores of cannon or small arms by the ignition of powder.

Fig. 754.

Milling Cutters. (*Bourn & Sharpe.*)

This form of instrument for the purpose derives its name from the fact that the pressure of the igniting powder is exerted upon a piston, the reverse of which has a cutter which makes a mark (cut) upon a copper block See, also, CRUSHER GAGE; PIEZOMETER

Plates III., X., accompanying Appendix I. *b*, to "*Report of Chief of Ordnance, U. S. A.*," 1877, are illustrations of such *cuts*, and the text accompanying pp. 373-396, describe the instrument and results, referring to Plates I.–X

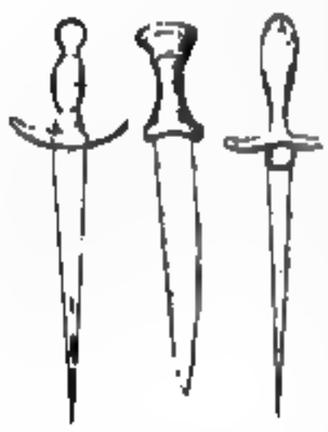
Several forms of cutters are there described

The Rodman cutter is also used in Lieutenant Metcalfe's recoil dynamometer for small arms. "*Ordnance Report*," 1878, Appendix N, p. 109.

— D —

Dag'ger. 1. A weapon with a pointed blade, adapted for stabbing.

Fig. 1588.



Daggers.

The words *dag* and *dagger* came into use about the twelfth century, but the knife is as old as Cain, or Abel it might be said, as he butchered sheep, and brought them and the fat thereof as a sacrifice.

The Romans carried secreted daggers (*dolo*) hidden in the handles of whips and canes.

The Venetians had daggers of glass with three-edged blades and a tube to secrete poison. By a sudden wrench the blade was broken off and remained in the wound, like the arrow-head of an Apache. Nice people both!

The *dagger* was a part of the equipment of the Frank warrior, who probably called it a *coutel*, or something like that. It does not differ materially from the *dirk* (*durk, duire*) of the Gadhelic branches of the Celts, or the *poniard* of those nations who acknowledge Latin (*pungere*, Lat., to prick) as the base of their mother tongues.

In the fourteenth century it was carried by citizens, yeomen, sailors, and ladies. It survives in England in the midshipman's *dirk*, and in other places as a *stiletto*, a *bowie-knife*, etc.

The *dagger* seems to have been a favorite instrument as an accessory to the soldier's equipment for close combat. The Highlander, Western desperado, and Chilian, all seem to approve of the mode of carrying it recorded of Ehud 1336 B. C.: "Ehud made him a dagger which had two edges, of a cubit length, and he did gird it upon his right thigh" (Judges iii. 16). The modern plan seems to be in the garter or the boot, unless it be worn in the belt, bosom, or down the back; *mirabile dictu*, such was known on the Mississippi and by "Arkansaw travelers."

Some ingenuity has been expended on this weapon in the mode of attaching it to the handle and providing the latter with a pistol.

2. (*Printing.*) A character (†) to call attention in the text to notes on the foot or margin of the page. As a reference-mark it comes next after the star (*).

A double dagger (‡) is another sign for a similar purpose when references are numerous.

Dahl'gren Gun. Named from the late rear-admiral John A. Dahlgren, of the United States navy. A gun in which the front portion is materially lightened and the metal transferred to the rear, giving the "bottle-shape," which caused some surprise on their first appearance in Europe.

Colonel Bomford, chief of ordnance of the United States army, commenced making this experiment previous to the war of 1812, and gave the name of "Columbiad" to the piece.

Dart. A missile spear or javelin much in use among the ancients, and yet seen among many of the more barbarous nations. The Caffres of South Africa and the aboriginal inhabitants of Australia are very expert in the use of the *assegai*. The darts in use among the ancients were of two kinds, namely, spear-headed (that is, without barbs), or barbed. The former were often attached to a long cord, enabling the thrower to recover his weapon after having thrown it. Dart-heads are usually made of iron, but among savage nations flints, sea-shells, fish-bones, and other hard substances, have been employed; and among some of the aboriginal inhabitants of Africa and America the dart was merely a sharp-pointed stick, the end of which was carbonized by fire. The weapon is always very simple in its construction, and is usually from 3 to 5 feet long.

Det'on-at'ing-ham'mer. The hammer of a percussion gun-lock.

Det'on-at'ing-pow'der. One which explodes by a blow. The compound used in the priming of percussion-caps and fuses is the fulminate of mercury or of silver, collected as a precipitate when the metal, dissolved in nitric acid, is poured into warm alcohol. The precipitate is collected, washed, and dried.

Det'on-at'ing-pri'mer. (*Blasting.*) A primer exploded by a fuse, and used in blasting operations to violently explode gun-cotton, instead of the former plan by which the charge of gun-cotton was simply ignited.

Di-or-rex'ine. An explosive analyzed by M. Fels.

Consists of Picric acid,	1.5	Nitrate potassium .	60
Wood charcoal . .	7	Nitrate sodium .	
Birch sawdust . .	10	Sulphur	12
		Water	9.5

Made principally at Brunn and Trieste.
"*Eng. & Mining Journal*," xxviii 263.

Another published recipe gives: —

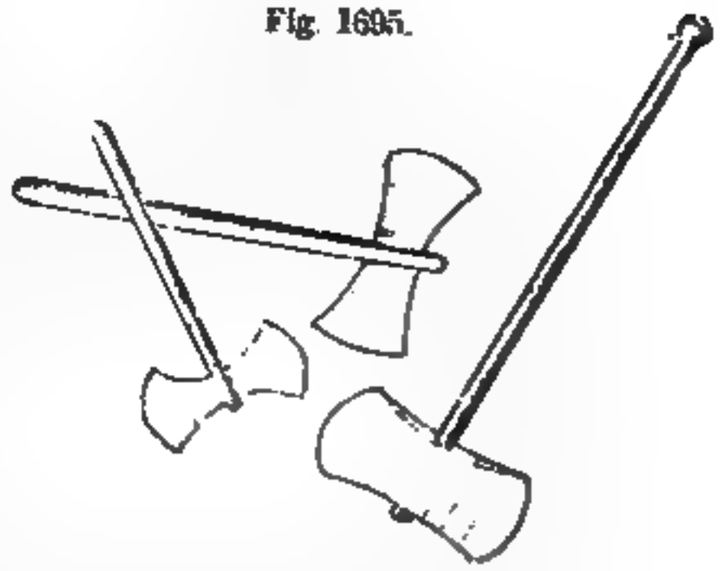
Nitrate of potassium	50
Nitrate of sodium	25
Sulphur	12
Hard wood sawdust	13
	100

Di-rect' Fire. 1. (*Fire-arms.*) That kind of action in which the plungers lie and strike the ignition in a line parallel with the axis of the barrel.

Double-bit'ted Axe. The axe has two opposite bits or blades. It is

an ancient form of battle-axe, being a favorite weapon with the Franks in the time of Clotaire, seventh century, and with the Danes in the time of Alfred the Great, ninth century.

Fig. 1695.



Double-Bitted Axe.

It is also shown in the sculptures of Karnak, in Egypt.

The battle-axe of the Scythians in the time of Herodotus was double-bitted. It is the Sacan *sagaris*.

Scylax, an historian of an age preceding that of Herodotus, compared Egypt to a double-bitted axe, the neck which joins the two heads being at the narrow part of the valley in the vicinity of Memphis.

The double-bitted axe is found in the tumuli and barrows of North America. It is in three forms: 1, with a circumferential groove for the occupation of the withe or split handle to which it is lashed; 2, with an eye traversing the head; 3, with a socket for the handle. See BATTLE-AXE.

Du'al-ine. Carl Ditmar's patent, No. 98,854, January 18, 1870. The composition is: —

Nitro-glycerine . . .	50 per cent.
Fine sawdust . . .	30 "
Nitrate of potassa . .	20 "

Compared with dynamite, it is, 1. More sensitive to heat, and also to mechanical disturbances, especially when frozen, when it may even be exploded by friction; 2. The sawdust in it has little affinity for the nitro-glycerine, and at best will hold but 40 to 50 per cent of nitro-glycerine, and on this account very strong wrappers are needed for the cartridges; 3. Its specific gravity is 1.02, which is 50 per cent less than that of dynamite, and as nitro-glycerine has the same explosive power in each, its explosive power is 50 per cent less than that of dynamite; [bulk for bulk?] 4. The gases from explosions, in consequence of the dualine containing an excess of carbon, contain carbonic oxide, and other noxious gases. Lithofracteur and dualine, however, can be exploded, when frozen, by means of an ordinary fulminating cap, which is not the case with dynamite. — *Journal of Applied Chemistry.*

Dyn'a-mite. An explosive compound invented by Nobel. "It is a mixture of 75 per cent of nitro-glycerine with 25 per cent of infusorial silica. The silica renders the powder less liable to explode from concussion. This is the dynamite proper, but dynamite is also used as a generic name for other mixtures of nitro-glycerine, — as colonia powder, which is gunpowder with a mixture of 40 per cent of nitro-glycerine; dualine, which contains 30 to 40 per cent of nitro-glycerine mixed with sawdust saturated with nitrate of potassia; lithofracteur, which contains 35 per cent of nitro-glycerine mixed with silica, and a gunpowder made with nitrate of baryta and coal."

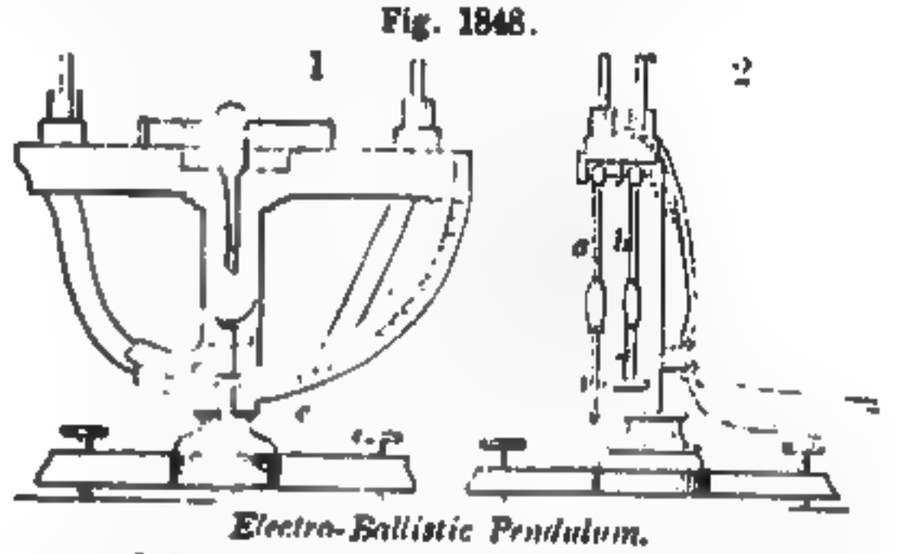
— E —

E-lec'tro-bal-lis'tic Ap'pa-ra'tus. An instrument for determining by electricity the velocity of a projectile at any part of its flight.

The projectile passes through a wire screen, thus breaking a current of electricity, and setting in motion a pendulum, which is arrested on the passage of the projectile through a second screen. The distance between the screens being known, the arc through which the pendulum vibrates measures the time due to the projectile's flight between the screens. See CHRONOGRAPH; BALLISTIC PENDULUM.

E-lec'tro-bal-lis'tic Pen'du-lum. Fig. 1848 1 is an elevation and 2 a section of the apparatus used in the United States Ordnance Department. The pendulums *a b* are suspended from the same axis, and are so adjusted that when each is brought to a horizontal position at the 90° mark on each side of zero at the middle of the arc *c* and let fall, they will meet precisely at the center. The bob of the inner pendulum *b* is provided with a marking point, the outer end of which is struck by a blunt projection on the outer pendulum *a*, when the two pass each other, impressing a mark on a sheet of paper clamped to the arc. See CHRONOGRAPH.

Fig. 1848.



Electro-Ballistic Pendulum.

En'field Ri'fle. The British infantry service-arm prior to the introduction of the breech-loading system. It was first extensively introduced in 1853, just prior to the Crimean War. It has three shallow grooves, which make one turn in 6 feet 6 inches, the length of the barrel being 3 feet 3 inches, and the diameter of the bore .577 of an inch. In construction and general appearance it very closely resembles the Springfield rifle musket (caliber .58 of an inch) of the United States service, with the exception that in the Enfield the barrel and other visible metallic parts are blued, while in the latter they are left bright. Large numbers of these rifles have of late years been converted into breech-loaders on the Snider principle. To these the term "Snider Enfield" is applied. See FIRE-ARM.

E'prou-vette'. 1. An apparatus for proving the strength of gunpowder.

One simple mode is to fire weighed charges and ascertain the range of the balls. A small quantity of powder, a heavy ball, and a short mortar reduce the range within convenient limits.

Another is to fire a small quantity beneath a shot attached at the foot of a vertical rod. The latter ascends, and, on reaching its greatest elevation, is prevented from descending by a pawl which engages a rack on the rod. The hight to which the shot ascends determines the strength of the powder.

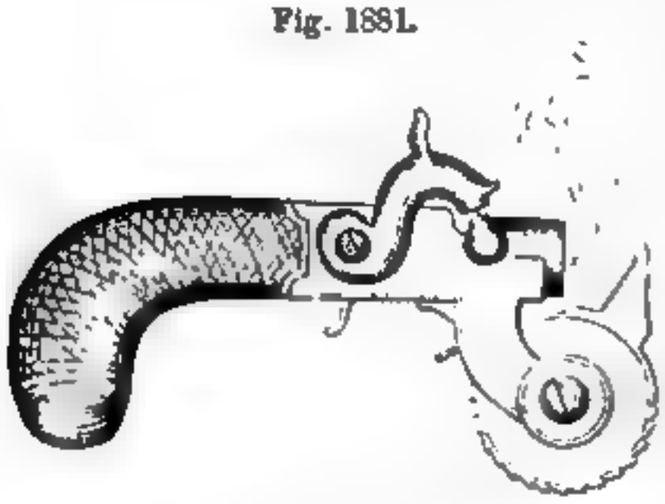
The éprouvette of Regnier is an adaptation of the Sector dynamometer. A small brass cannon is attached to one arc and charged with a given quantity of powder. A projection from the other arc comes

in front of the muzzle, and the parts are separated when the explosion takes place.

A cursor over the graduations indicates the point reached by the force of the explosion. See BALLISTIC PENDULUM.

A convenient and portable éprouvette is an instrument shaped like a small pistol without a barrel, and having the forward end of its charge-chamber closed by a flat plate connected with a spring. On the explosion of the powder against the plate, the latter is driven forward to a distance proportioned to the strength of the powder, and is retained at its extreme range of propulsion by a ratchet-wheel and spring-click.

Fig. 1881.



Éprouvette.

Pouillet's chronoscope and Navez's electro-ballistic apparatus, by measuring the velocity attained by balls with charges of certain powders, form good *éprouvettes*. See CHRONOSCOPE; ELECTRO-BALLISTA.

2. (*Metallurgy.*) A flux spoon. A spoon for sampling an assay.

Eprou-vette'-gun. The gun-éprouvette determines the strength of the powder by the amount of recoil produced. A small piece of ordnance is fastened to a frame which is suspended as a pendulum so as to vibrate in an arc when the piece is fired. A pointed iron rod projects downward from the gun, and travels in a groove of soft wax as the gun recoils, thus making a mark which is measured to determine the length of the arc. A graduated arc with an index-finger is used in the British service. The gun is of brass, 1¾ inch bore, 27.6 inches long, weighs 86½ pounds; suspended from a frame and charged with two ounces of powder without shot or wadding.

The éprouvette-mortar of the British service is 8 inches in diameter, and is charged with 2 ounces of the powder, and an iron ball of 68½ pounds weight; average range of 265 feet. The government powder, somewhat deteriorated and reserved for blasting, gives a range of 240 feet.

The French éprouvette-mortar has a caliber of 7 inches; charge, 3 ounces; projectile, a copper globe of 60 pounds; required range, 300 yards.

The éprouvette-mortar of the United States service is a 24-pounder, having a chamber to contain one ounce of powder, and no windage to the ball. The required range for new powder, 250 feet.

Ex-pand'ing-ball. One having a hollow conical base, affording a relatively thin body of metal, which is expanded by the force of the explosion, driving it closely against the bore of the gun and into the

Ex-plo'sive-ball. One having a bursting-charge which is ignited on concussion or by time fuse. See SHELL.

Ex-plo'sive Bul'let. Two explosive bullets are mentioned under BULLET.

These were intended for war, but the military service of civilized nations has not been disgraced by their use to any extent.

Fig. 990.

Explosive Shell.

The Dougall explosive bullet for heavy game is made thus: In pouring the bullet a small copper bottle is suspended in the center of the mold, so that it is inclosed by the lead except at the front where a tige holds the bottle and forms the future charging opening. It is charged with equal parts of sulphuret of antimony and chlorate of potassa, or with common powder, and primed with a fulminate. It is used for elephant, lion, tiger, and alligator shooting especially.

Ex-plo'sives. Gunpowder was in use as far back as the twelfth century, and its composition, as shown by old manuscripts, did not differ greatly from the most approved modern manufacture. See GUNPOWDER.

Berthollet proposed to substitute chlorate of potash for saltpeter in the manufacture of gunpowder. The explosive force was in this way doubled, but it was found to explode too readily, and, at a trial in loading a mortar, at Essonnes, 1788, the powder exploded when struck by the rammer, blowing mortar and gunners to pieces.

Fulminates of gold, silver, and mercury were experimented with in the early part of this century, as substitutes for gunpowder. Fulminate of mercury is obtained by dissolving mercury in nitric acid and adding a certain proportion of alcohol and saltpeter to the mixture. It is used extensively in the manufacture of percussion-caps and cartridges, but none of the fulminates are likely to be used in large quantities, as being too expensive and dangerous. In an experiment at Paris, a grain of fulminate of gold was placed on an anvil and exploded by a blow from a sledge, making a dent in both hammer and anvil.

Pyroxyline, or gun-cotton, was discovered by Schoenbein in 1846. It is prepared by immersing cotton in a mixture of nitric and sulphuric acid for a few minutes, and then washing and drying it. It has been experimented with by several European nations in connection with fire-arms, but was found to be dangerous, and to rapidly destroy the arms by its excessive energy, and was abandoned by all but the Austrians, who utilized the improvements of Baron Lenk in gun-cotton, and have several batteries of artillery adapted to use the improved composition. Abel's English gun-cotton is now used for petards and in mining. Several compounds based on gun-cotton are used in the arts, as in collodion for photography, surgery, etc.

Nitro-glycerine, which is pure glycerine treated with nitric acid, was discovered by the Italian chemist Sobrero in 1847, but was very little used until 1863, when it was utilized by Nobel for blasting. The explosive energy of this compound is given as from four to thirteen times that of rifle powder. By an explosion of a few cans of this material on the wharf at Aspinwall in 1866, a considerable portion of the town was destroyed, shipping at some distance in the harbor much damaged, and a number of lives were lost. An explosion of a storehouse containing some hundreds of pounds of nitro-glycerine took place at Fairport, Ohio, in 1870, accompanied with much loss of life. The shock was felt at Buffalo, 160 miles distant.

Nobel, in 1867, invented a compound called dynamite, which consists of three parts nitro-glycerine and one part of porous earth. Dynamite is supposed to be safe against explosion from con-

cussion or pressure. See DYNAMITE.

Dualine differs from dynamite in the employment of sawdust with nitro-glycerine, instead of earth or silica. See DUALIN.

Picrate of potash is a yellow salt, extremely explosive, formed from potassium, by the action of picric acid, a product of the distillation of coal-tar. It was experimented with by the French War Department to some extent, and was demonstrated to lie between gunpowder and dynamite in its explosive force.

M. Berthelot gives, in *Annales de Chimie et de Physique*, a table showing the relative force of explosives. From this table is deduced the following, expressed in terms of our own standard measurements: —

	Quantity of heat disengaged by one ounce. Heat units	Volume of gas formed. Cubic feet.	Relative pressure developed, the pressure of hunting-powder being taken as unity.
Hunting-powder	147,871	0 216	1
Cannon powder	140,215	0 225	0.996
Mining-powder	117,467	0 173	0 689
Mining-powder with excess of niter	155,472	0.111	0.540
Powder with nitrate of soda base	176,432	0.248	1.838
Powder with chlorate of potash base	224,389	0.318	2.225
Chloride of nitrogen	72,784	0.370	0 842
Nitro-glycerine	306,337	0.710	6.797
Gun-cotton	145,337	0 801	3.636
Gun-cotton mixed with nitrate	228,371	0.484	3.456
Gun-cotton mixed with chlorate	327,528	0.484	4.594
Picric acid	160,309	0.780	3.910
Picric acid mixed with nitrate	223,515	0.406	2.722
Picric acid mixed with chlorate	328,909	0 406	4.196
Picric acid mixed with oxide of lead	49,981	0 120	0 106
Picric acid mixed with oxide of copper	94,204	0.270	0.785
Picric acid mixed with oxide of silver	60,576	0.116	0.208
Picric acid mixed with oxide of mercury	43,762	0 212	0 288
Picrate of potash	135,663	0 585	2.476
Picrate of potash mixed with nitrate	197,161	0 337	2 069
Picrate of potash mixed with chlorate	328,449	0.337	3.574

— F —

Field-gun. A light cannon designed to accompany troops in their maneuvers on the field of battle. At the commencement of the late civil war in this country, those thus denominated were the 6-pounder, weighing 885 pounds; the 12-pounder, of 1,770 pounds; a light 12-pounder of 1,220 pounds; and the 12, 24, and 32-pounder howitzers, weighing respectively 780, 1,320, and 1,820 pounds. These were all made of bronze. During the war several kinds of rifled field-guns were introduced, but only two maintained their place in the military service; the 3-inch wrought-iron rifle and the Parrott 10-pounder of 2.9-inch caliber, each nearly the weight of the bronze 6-pounder, and carrying an elongated projectile of ten pounds weight. The smooth-bores generally were withdrawn from the field during the war, with the exception of the light 12-pounder, or "Napoleon" gun.

Four smooth-bore guns and two howitzers, or six rifled or six 12-pounder guns with their carriages, caissons, forge, and battery-wagon, constitute a battery. No particular kind of breech-loading gun has been adopted in the United States Service, unless the Gatling machine-gun may be so classed. See BATTERY-GUN. Most, if not all, European governments have adopted breech-loaders of various kinds for field service.

The English use the breech-loading Armstrong gun (see ARMSTRONG-GUN) for field, fortification, and naval service.

The Prussian army uses two calibers of field-guns, 4 and 6 pounders, both rifled steel breech-loaders. The bore of the barrel extends entirely through. The breech of the 4-pounder is closed by a double wedge sliding in a horizontal slot through the barrel. The 6-pounder is closed by a plug held in place by a large steel pin. The escape of gas is prevented by a gas ring on the Broadwell plan, similar to that in a Sharp's rifle. See GAS-RING.

Fire-arm. A weapon which projects a missile by the explosion of gunpowder. It succeeded the long and cross bows, but the periods of the two weapons in Europe lapped upon each other. (See ARROW; Bow.) The bow and arrow are yet used by millions in Asia, Africa, and America, but the owners are always glad to trade for muskets and rifles.

The first fire-arms were doubtless rockets, in which the force of the explosion carried the tube. To these probably succeeded something of the nature of the fire-works known as Roman candles, in which pellets are loaded into a tube and fired by a match at the tube-mouth. The tubes were of bamboo, paper, or cloth, probably each of these, according to circumstances. (For early notices, see GUNPOWDER.) The cracker was used as a grenade anciently in China, and in the 8th century by the Greeks.

The first fire-arms used in Europe were cannon. (See ARTILLERY; CANNON.) Fire-arms to be carried by the soldier were a later invention. The *arquebus* was used in 1480. The musket by Charles V. in 1540. These used matches or match-locks. The wheel-lock was invented 1517; the flint-lock about 1692. The percussion principle by the Rev. Mr. Forsythe, in 1807. See GUN-LOCK.

For varieties, see under the following heads: —

Accelerator.
Armstrong-gun.
Arquebus.
Barbette-gun.
Battery-gun.
Birding-piece.
Blunderbuss.
Bombard.
Breech-loader.
Bysse.
Calabass.
Cannon.
Carbine.
Carronade.
Casemate-gun.
Chassepot-gun.
Coehorn.
Columbiad.
Culverin.
Dahlgren-gun.
Double-barreled gun.
Enfield-rifle.
Eprouvette.
Gatling-gun.
Gun.
Howitzer.
Jingal.
Lancaster-gun.
Magazine fire-arm.
Mitrailleur.
Mortar.
Musket.
Musketoon.
Needle-gun.
Ordnance.
Parrot-gun.
Pistol.
Pistol-carbine.
Pivot-gun.
Repeating fire-arm.
Revolver.
Rifle.
Shot-gun.
Shunt-gun.
Siege-gun.
Small-arm.

Field-gun.
Fowling-piece.
Fusil.
Swivel-gun.
Tinker.
Whitworth-gun.

This article treats of breech-loading small-arms generally; *magazine fire-arms*, *needle-guns*, *revolvers*, *pistols*, *cannon*, and *battery-guns* are also considered under their respective heads.

Abraham Hall's English patent, 1664, had "a hole at the upper end of the breech to receive the charge, which hole is opened or stopped by a piece of iron or steel that lies along the side of the piece, and movable by a ready and easy motion."

Henry VIII. took much interest in fire-arms, and two weapons, yet extant, manufactured during his reign, were substantially the same as the modern Snider rifle.

"It was in 1430," says Biblius, "that small-arms were contrived by the Lucquese, when they were besieged by the Florentines." A French translation of Quintius Curtius, preserved in the British Museum, has the earliest illustration of hand fire-arms yet discovered. The cut is from the "Penny Encyclopædia."

Fig. 1983.

Fire-Arm of the Fifteenth Century.

In the *Musée d'Artillerie*, Paris, is a breech-loading arm of the time of Henry II. of France, prior to 1550, and a match-lock revolver of the same period.

In the *United Service Museum*, of London, is a revolver of the time of Charles I. It is called "a snaphaunce self-loading petronel." It has a revolving cylinder containing seven chambers with touch-holes. The action of lifting the hammer causes the cylinder to revolve, and a fresh chamber is brought into connection with the barrel. Six of the seven chambers are exposed to view, and the charges are inserted without the aid of a ramrod.

Speaking generally, the early hand-guns were breech-loaders. See REVOLVER.

Among the curiosities of this branch of invention is Puckle's English patent, No. 418, May 15, 1718. The accompanying illustration is from the original drawing attached to the patent, and the description following is that filed by the inventor.

"A DEFENCE.

Defending KING GEORGE, *your* COUNTRY *and* LAWES
In defending YOURSELVES *and* PROTESTANT CAUSE.

A Portable Gun or Machine, called a Defence. For Bridges, Breaches, Lines, and Passes, Ships, Boats, Houses, and other Places.

No. 1. The barrel of the gun.
2. The sett of chambers charg'd put on ready for fireing.
3. The screw upon which every sett of chambers play off and on.
4. A sett of chambers ready charg'd to be slip'd on when the first sett are pull'd off to be re-charg'd.
5. The crane to rise fall and turn the gun round.
6. The curb to level and fix the guns.
7. The screw to rise and fall it.
8. The screw to take out the crane when the gun with the trepeid is to be folded up.
9. The trepeid whereon it plays.
10. The chain to prevent the trepeids extending too far out.
11. The hooks to fix the trepeid, and unhook when the same is folded up in order to be carried with the gun upon a man's shoulder.

No. 12. The tube wherein the pivot of the crane turns.
13. A charge of twenty square bullets.
14. A single bullet.
15. The front of the chambers of a gun for a boat.
16. The plate of the chambers for a gun for a ship, shooting square bullets against Turks.
17. For round bullets against Christians.
18. A single square chamber.
19. A single round chamber.
20. A single bullet for a boat.
21. The mold for casting single bullets."

The parts of a gun are: —

Ante-chamber; the cavity which connects the hollow of the nipple with the chamber in the breech.

Barrel; the tube out of which the load is discharged.

Bead; the silver knob for sighting on the end of the barrel.

Bolt; the sliding piece which secures the barrel to the stock.

Breech; the piece containing the chamber which screws into the barrel.

Butt; the broad end of the stock which is placed to the shoulder.

Cap; the brass tube which incloses the worm of the ramrod.

Chamber; the cavity of the breech in which the powder is deposited and exploded.

False-breech; the iron piece on the gun-stock which receives the breech-claws, and assists in holding the barrel firmly to the stock.

Guard; the metallic scroll which defends the triggers.

Heel-plate; the plate on the butt.

Lock; the piece of many parts by which the gun is fired. See GUN-LOCK.

Loop; the clasp on the barrel through which the bolt passes and secures it to the stock.

Nipple; the tube on which the cap is placed, and through which the powder reaches the charge.

Nipple or *cone wrench;* a small turning tool for securing or loosening the nipple, to and from the barrel.

Pipes; short tubes which hold the ramrod to the barrel.

Rib (upper and under); the center-piece which unites the barrels

Side-nail; the screw which fastens the lock to the barrel.

Sight (breech and muzzle); an object or depression on the breech, a bead or knob on the muzzle, by bringing which into line with the object the line of fire is directed.

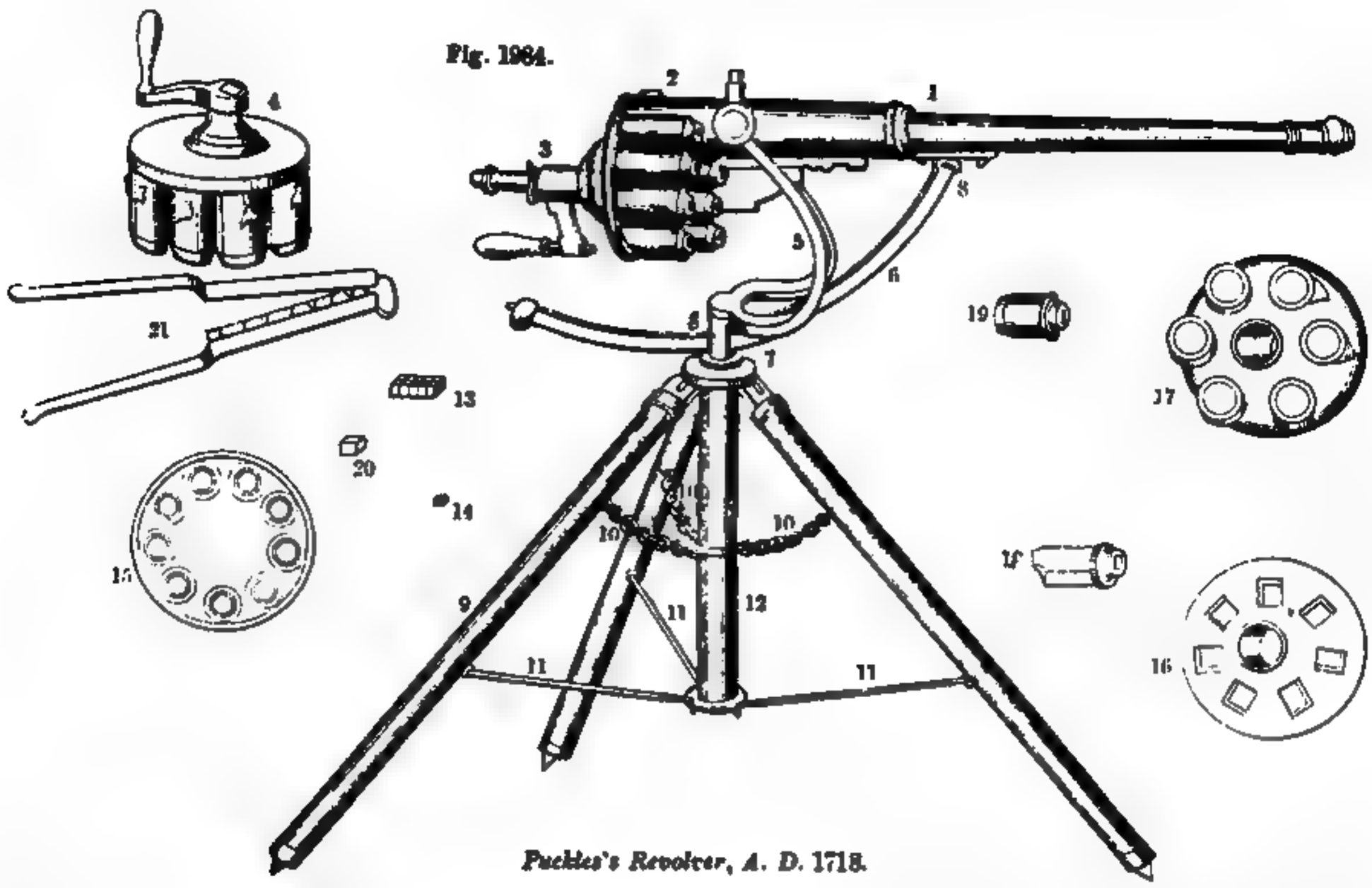
Trigger-plate; the iron plate in which the triggers work.

Worm; the screw at the end of the ramrod.

Of the gun-lock the parts are the

Bridle.
Chain, or swivel.
Cock, or hammer.
Lock-plate.

Fig. 1964.



Puckle's Revolver, A. D. 1718.

Main-spring.
Sear.
Sear-spring.
Spring-cramp.
Trigger.
Tumbler.
Tumbler-screw.

See GUN-LOCK.

The first patent in the United States for a breech-loading fire-arm was to Thornton and Hall of North Yarmouth, Mass., May 21, 1811. Between that time and 1839 more than 10,000 of these arms were made and were issued to the troops in garrison and on the frontier. This gun is represented at *N*, Plate 16, and had a breech-block, which was hinged on an axial pin at the rear, and tipped upwardly at front to expose the front end of the charge-chamber. The flint-lock and powder-pan were attached to the vibrating breech-block. The arm is shown and described in detail in General Norton's "American Breech-Loading Small-Arms," New York, 1872.

Before the war of 1861–65, the principal breech-loading small-arms were Sharps's, Burnside's, Maynard's, Merrill's, and Spencer's.

Sharps's rifle (*O*, Plate 16) has the barrel rigidly attached to the stock, the rear being opened or closed by a vertically sliding breech-block, which slides up and down in a mortise operated by the trigger-guard, which is pivoted at the front end, or by a lever.

The primer consists of small pellets of fulminate inclosed in a copper casing so as to be water-proof. These are placed in a pile in a hole in the lock-plate, forced upward by a spiral spring, the upper one fed forward by a plunger, caught by the cup of the hammer, and carried down upon the nipple. The cartridge is in cloth, the end covered with tissue-paper saturated with saltpeter, through which the fulminate will ignite the powder.

Burnside's rifle (*P*) has the barrel attached to the stock, the breech-piece being pivoted beneath the barrel, so as to swing downward and expose the chamber in the front end of the breech-piece for the insertion of the cartridge.

In Maynard's rifle (*D*) the barrel is pivoted to the front end of the stock, and its rear end tips upwardly, exposing the chamber for the cartridge, when the barrel is tipped down against a solid breech-piece and locked. The Maynard primer consists of pellets of fulminate placed at regular intervals between narrow strips of paper. This is coiled in a chamber in the lock-plate, and is fed forward by a wheel operated by a hammer, so as to bring a pellet on top of the nipple at each discharge.

The Merrill gun (*E*) was constructed for a paper cartridge. The breech was closed by a sliding plug locked in place by a combination of levers. The charge was exploded by a copper cap, placed upon the nipple in the ordinary manner.

The Spencer rifle (*F*) is both a magazine and a single breech-loader, seven cartridges being placed in a magazine in the but, and being thrown forward to the chamber as required. The breech-block is a sector pivoted beneath the level of the barrel, and retreating backward and downward to expose the rear of the bore for the insertion of the cartridge. The trigger-guard forms the lever for moving the breech-block.

The Roberts gun (*L*) has a breech-block pivoted at the rear, operated by a lever which extends backwardly over the small of the stock; the forward end of the breech-block being depressed, the center of its motion and its abutment in firing being a concave solid base centering on the exact prolongation of the axis of the barrel. The breech parts are four in number, articulated without pins or screws. The firing-pin passes centrally through the breech-block, and is driven forward on the center of the cartridge by a blow of the hammer.

The Martini gun (*A*) is the invention of a Swiss. The breech-block is pivoted at its upper rear portion, being moved up and down by a lever at the rear of the trigger-guard. The firing is by a spiral spring, which actuates a firing-pin. The cartridge-shell extractor works on a pivot below and behind, the barrel

being operated by the descent of the front end of the breech-block upon one arm of the bell-crank lever.

The Chassepot gun (*B*) is the French arm, and is named after its inventor. It is what we term a bolt-gun, an opening on the right hand of the chamber admitting the insertion of the cartridge. The forward thrust of a knob drives the cartridge into the breech, and a partial rotation of the knob locks the breech-piece. The firing is by a needle.

The Prussian needle-gun (*C*) is also a bolt-gun, having an inner bolt which forms the firing-pin, a sleeve around it, and an outer cylinder. The parts are shown with the needle in its fired position. In preparing to reload, the rear knob is withdrawn, and the axial bolt retained by a catch which engages a projection, withdrawing the needle. The chamber is then unlocked by the knob and slid back, the cartridge inserted and driven into the breech by the chamber, which is locked by a partial rotation. The firing is done by releasing the needle-bolt.

The Laidley gun (*G*) has a breech-block pivoted beneath the barrel and rotating backward and downward to open the chamber. When in position for firing, it is fastened by a locking-brace which is operated by a spring, and vibrates on the same axis as the hammer. The breech-block is unlocked by a cam and thrown back by a pawl attached to the locking-brace and actuated by the hammer.

The Westley-Richards gun (*H*) is an English arm having a pivoted breech-block whose front end is depressed by the action of a lever pivoted to the stock beneath the rear of the barrel.

The Snider gun (*I*), built at Enfield, England, is similar to our Springfield converted rifle, of which presently. The breech-block is hinged to the rear of and above the barrel, the block throwing upward and forward, exposing a chamber in rear of the bore. Into this the cartridge is dropped, pushed into the bore, the block brought down and locked by a latch in the rear. The firing-pin passes obliquely through the block and is struck by the ordinary hammer.

The Berdan form of this type is shown at *J*, and has a breech-block in two sections hinged together.

K is the Peabody gun, which has a falling breech-block, hinged at the rear and depressed by the guard-lever, whose short arm engages in a recess of the block and controls its movements. When the block is down, the cartridge is slipped into the bore, and the piece is fired by the fall of the hammer upon a firing-pin sliding in a groove in the side of the block. In opening to reload, the block drops upon an elbow lever and withdraws the spent cartridge-shell.

Allen's gun (*M*) is double-barreled, and the breech-block is hinged at the side, swinging upwardly and laterally. It carries both firing-pins, and is locked shut by a latch.

Plate 17 gives views of the three arms recommended this year (1873) by the army commission at Springfield.

R is the Springfield arm, having a breech-block hinged to the upper edge of the barrel and swinging upward and forward. The indorsement of the board, as the best all things considered, entitles it to an honorable place in the series of examples. *R* is a side view of the gun, with the breech-block *d* thrown up; *a* is the bottom of the receiver, *c* the breech-pin, with its circular recess to receive the cam-latch *f*, which locks the breech-block in place; *g* is the cam-latch spring, *h* is the firing-pin, which transmits the blow of the hammer to the priming of the cartridge, and is pressed back by a spiral spring after the delivery of the blow; *j* is the cartridge-shell ejector, *k* its spring; *l* an incline which tips up the ejected shell so as to throw it out of the receiver.

R' is a top view of the gun with block closed. *R²* is a longitudinal vertical section with the breech-block closed. The dotted lines show the block raised.

The breech-block is raised upward and forward in the act of opening by a thumb-piece *m*, which releases it by turning up the cam-latch out of its recess in the breech-pin. When fully open, it discloses the chamber, or rear end of the barrel, ready for the insertion of the charge contained in a copper cartridge-case, holding seventy grains of musket-powder, and firing a bullet $\frac{44}{100}$ of an inch in diameter and weighing about 400 grains. When the breech-block is closed, it is held down and braced against the effort of the heaviest charges by the cam-latch, which flies into place in closing. The piece is fired by the ordinary side-lock taken from the old muzzle-loaders. In opening the piece after firing, the breech-block strikes the lump on top of the extractor, and revolves it so as to carry the now empty cartridge-shell to the rear. After passing a certain point, the spiral spring in front of the extractor is released, and accelerates its motion, so that the cartridge is thrown sharply against the beveled surface of the ejector-stud, by which it is deflected upward and expelled from the gun.

S S' are two views of the Elliot carbine recommended by the same board for trial in the field, as exhibiting "remarkable facility of manipulation in requiring but one hand to work it." This arm has a breech-block hinged to the breech-pin and operated by the hammer. Fig. *S* shows the gun in loading position, and *S'* in the position "ready to fire." After firing, the hammer *d* is pulled back to the position shown in *S*, and in so doing draws by the yoke *b* upon the breech-block *a*, to which it is pivoted at *c*. This pulls down the front end of the breech-block, exposing the rear of the barrel for the insertion of the cartridge. Having done this work, the pin *e* of the yoke slips out of the socket *f* into the lower portion of the groove, while the lower branch of the yoke engages over the pin *g*, so that when the hammer is again pulled back, the breech-block is pushed up again into the position shown at *S'*, where the hammer is on full cock and the arm ready to fire. *h* is a strap which works the retractor, so that the shell is ejected as the breech-block is pulled down. *S* shows the cartridge-ejector pulled out; *S'* shows it in its bed. One pull on the hammer depresses the breech-block and ejects the empty shell; another pull closes the breech-block and puts the hammer in position for firing; a pull on the trigger fires the arm.

T T' are two positions of the Ward-Burton gun, which is on the *bolt* principle, like the Prussian needle-gun and the French Chassepot. This gun, in its magazine form, was also recommended "for farther trial in the field." This gun, having been fired, is opened by raising the handle *a* of the bolt and withdrawing it directly rearward; the position is shown in Fig. *T'* of Plate 17. As the cartridge-

shell is pulled out by the spring-hook on the upper edge of its flanged rim, the pin which rests against its lower portion comes in contact with the front end of the trigger-pin, which tips it up and throws it out of the receiver. Another cartridge is then introduced by hand or by automatic devices from the magazine, and pushed into the bore of the gun by the longitudinal forward motion of the bolt. Near the head of the bolt is seen a part of the sectional screw which engages with a corresponding section within the gun when the piece is closed, and the handle turned down into place, so as to support the bolt against the force of the discharge. The firing-pin is an axial spring-pin released from the bolt by a downward pull by means of the trigger and lever. Fig. *T* is the position "ready to fire," the driving-spring being condensed and ready to act. Fig. *T'* shows the bolt withdrawn and the cartridge tumbling out. When the bolt is withdrawn, the sleeve of the firing-pin is so far retracted that a shoulder catches behind the trigger. When the bolt is pushed home, driving the cartridge into the barrel, it leaves the shoulder of the firing-pin resting against the trigger, as shown in Fig. *T*.

Plate 18 shows three other American forms of fire-arms, and the Swiss adopted pattern, which is a bolt needle-gun.

U U' are two positions of the Remmington gun; the left-hand figure is "fired," the right-hand "ready to load." The breech-block *b* swings upon a strong pin within a mortise of the stock. *c* is a tumbler which braces the breech-piece against recoil at the time of firing, and forms a part of the hammer which strikes a firing-pin, which passes through the tumbler and is driven against the cap or part of the cartridge-case containing the fulminate.

The breech-piece *b* and tumbler *c* are so formed that when the former is closed the rounded upper portion of the tumbler works in a concavity in the back of the breech-piece, as shown in Fig. *U*, and when the hammer is drawn back to half-cock or full-cock the rounded back of the breech-piece works in a concavity in the front of the tumbler, as shown in Fig. *U*. This mode of matching the breech-piece and tumbler prevents the possibility of the hammer falling until the breech-piece is perfectly closed, and so obviates the possibility of premature explosion of the charge. The extractor, by which the discharged cartridge-shells are drawn out from the chamber of the barrel, works between the receiver and the breech-piece, and is operated by the opening movement of the latter. The breech-piece is opened by the thumb-piece. A guard-lever *d* prevents the trigger being drawn when the breech-piece is open.

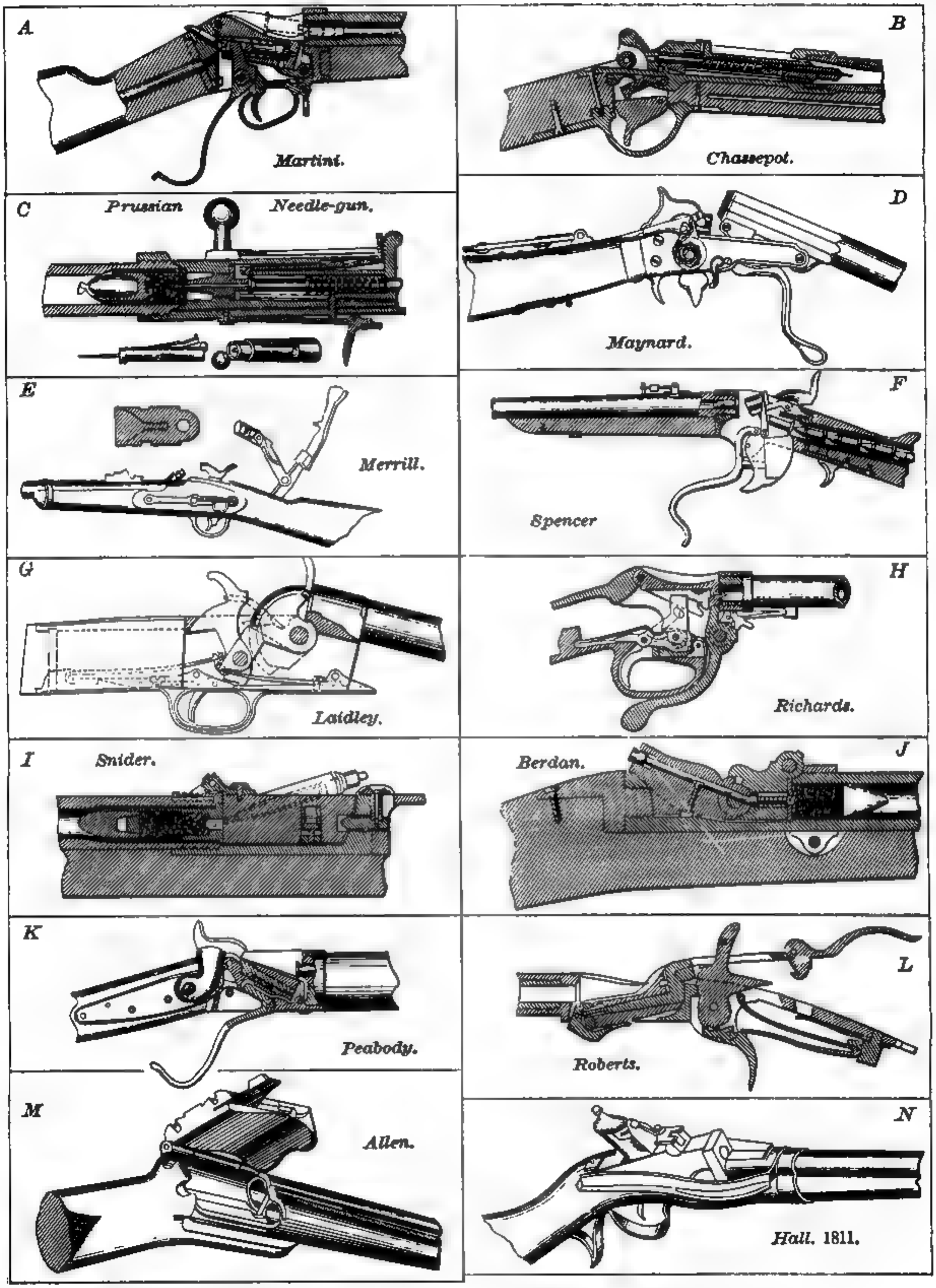
W W' are two views of the Dodge breech-loader, shown as a double-barreled breech-loading fowling-piece. *W* is a perspective view, and *W'* a sectional view. The barrels are hinged to the front end of the stock, so as to tilt upwardly at the rear and nearly balance upon the hinging-point, the motions being made by means of the pivoted lever *d*, which laps over the trigger-guard and locks the barrels in firing position by engagement of a hook *c* with a pin passing through the lug *g*. The front end of the lever extends beyond the pin on which it turns, and works in a slot in the center of lug *g* beneath the barrels, which it serves to elevate and depress. As the barrels are elevated, the front end of the lever strikes against a projection on the stem of the extractor, and retracts the spent cartridge capsule. The frame *e* is made of a single piece of metal extending from the front, where the barrels are hinged, to the grip in the rear of the breech; and the locks are fitted in recesses therein, dispensing with separate lock-plates. The locks are "rebounding," that is, they go forward and fire the cap and return to half-cock. The hammers draw back the firing-pin when full-cocked. The barrels are adjusted on the frame, and wear is compensated by means of the block *b*. In use, the left hand need not be moved from where it is in firing; the breech is brought under the right arm, the lever thrown down, fresh cartridge inserted, the lever returned, the hammer cocked, and the piece is ready to fire.

The gun adopted by the Swiss Federal government has the magazine and cartridge-carrier of the Winchester, with the needle-exploder and bolt breech. The large figure is a longitudinal central section; *x* is a perspective view of the bolt, firing-pin, and lever detached; x^1 is a view of a piece of the breech-cylinder; x^2 is a view of the cartridge-carrier detached. The motions are as follows: the lever *a* is raised, rotating on the firing-pin *b*, and cocking the latter by the pressure of a cam upon the transverse trigger-bar *c*; the bolt is then drawn back, carrying the firing-pin and the hook, which retracts the spent cartridge; the motion eventually rocks the bell-crank lever *d* and raises the carrier *e*, which brings another cartridge in line with the barrel. The bolt *h* is then pushed back, pressing down the carrier *e* and driving the cartridge into the barrel; a partial rotation of the bolt, by means of the lever *a*, locks it firmly by the catching of studs *f* on the bolt behind lugs *g* on the breech-cylinder. The firing-pin has remained on cock since the first motion of semi-rotation of the bolt, and is now pulled off by the trigger. The combination is known as Vetterlin's.

F' is the Henry magazine rifle, now known as the Winchester repeating-gun. It may be used as a single-loader or a repeater. As a repeater, the motion of the lever *a* withdraws the spent shell of the previous charge, raises the hammer, recharges the gun, and relocks the breech mechanism. The magazine contains seventeen cartridges, which can be discharged in as many seconds. With single loading, the cartridge is placed in the carrier-block, and a single motion puts it in order for firing. The cartridges are placed in the magazine by pressing them through the trap *b* on the right-hand side of the gun, the magazine being easily filled while the gun swings at the side. They are fed from the magazine into the carrier-block by a spiral spring.

Y is a section of the gun immediately after discharge; *c* is an empty shell; *d* one in the carrier-block; *e*, one in the magazine; by the forward motion of the lever *a* the links take the position shown in *Y'*, the piston *g* is withdrawn, raising the hammer to the full-cock, and extracting the empty shell *c*, which is thrown upward at the same time the carrier-block *h* with the carriage which it contains is raised by the lever *i* placing the cartridge opposite the chamber. This position is seen at *Y'*. The returning motion of the lever drives the piston forward, leaves the hammer at full-cock, forces the cartridge contained in the carrier-block into the chamber, drops the carrier-block to receive the following cartridge from the magazine, and places the arm in readiness to be fired.

The United States has adopted the Springfield.



England adopts Snider's improvement on the Enfield.

France, the Chassepot.
Belgium, the Albini.
Holland, the Snider.
Turkey, the Remington and Winchester.
Austria, the Wanzl.
Sweden, the Hagstrom.
Russia, the Laidley and Berdan.
Switzerland, the Winchester.
Portugal, the Westley-Richards.
Prussia, the needle-gun. The well-known form

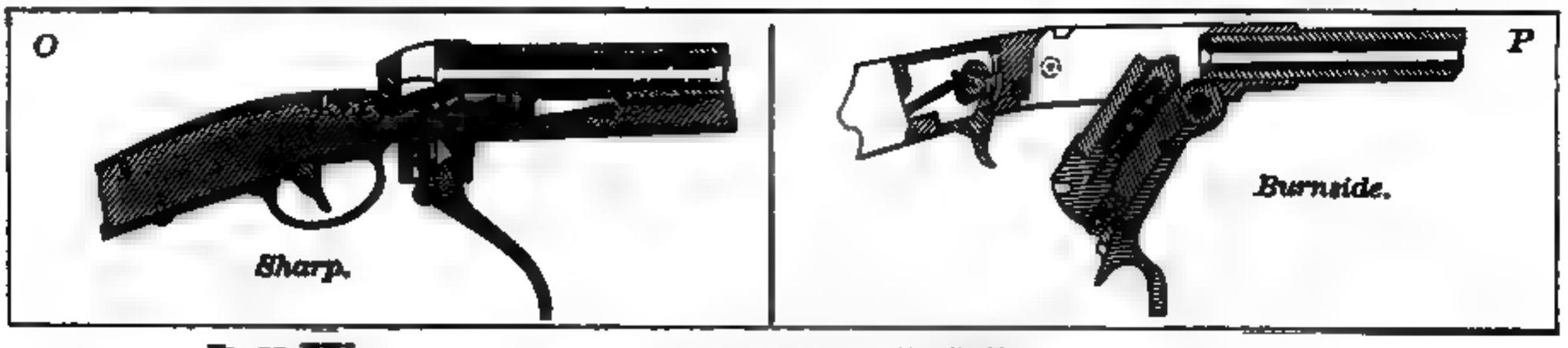
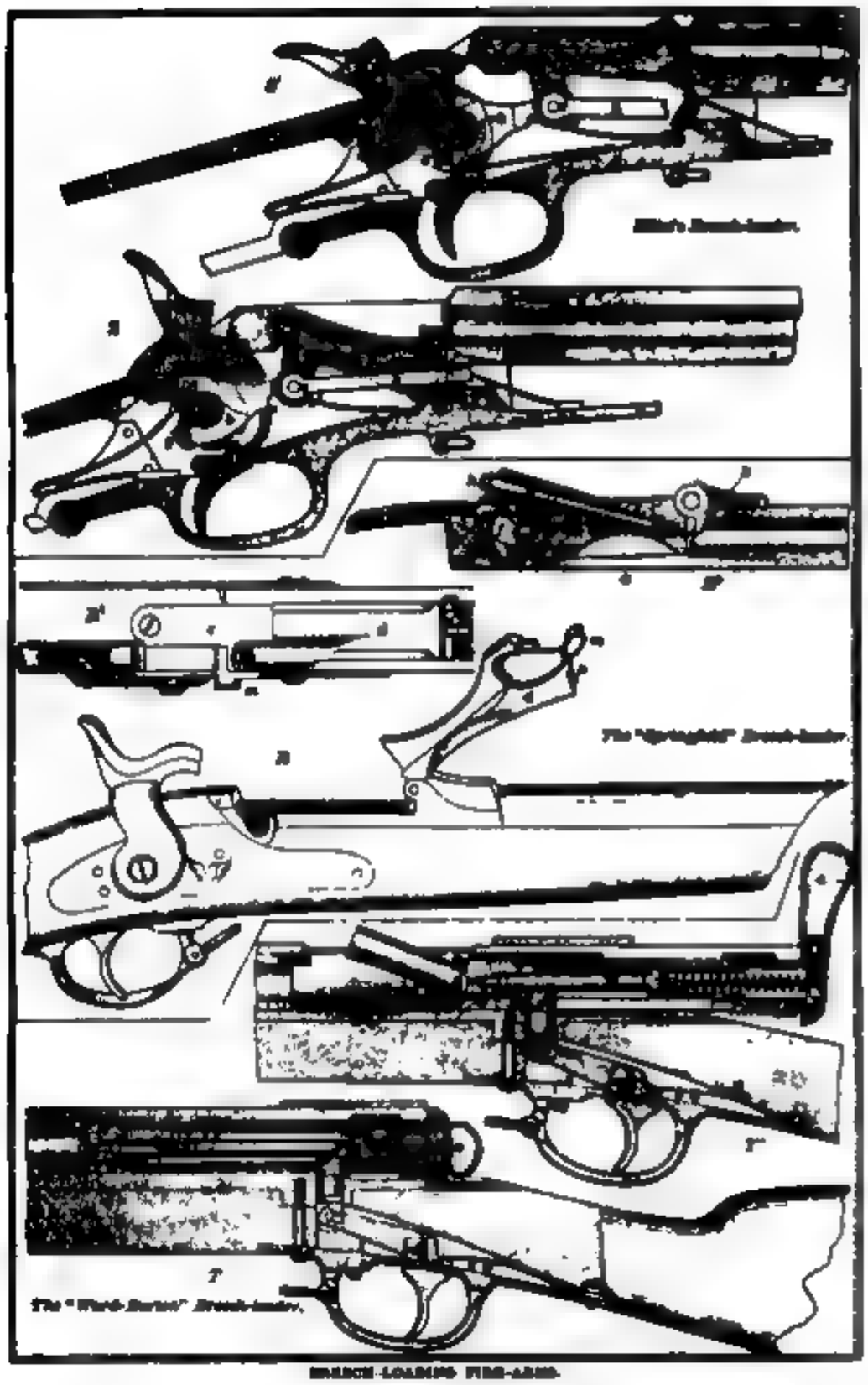


PLATE XVI. BREECH-LOADING FIRE-ARMS.
(*American and European.*)



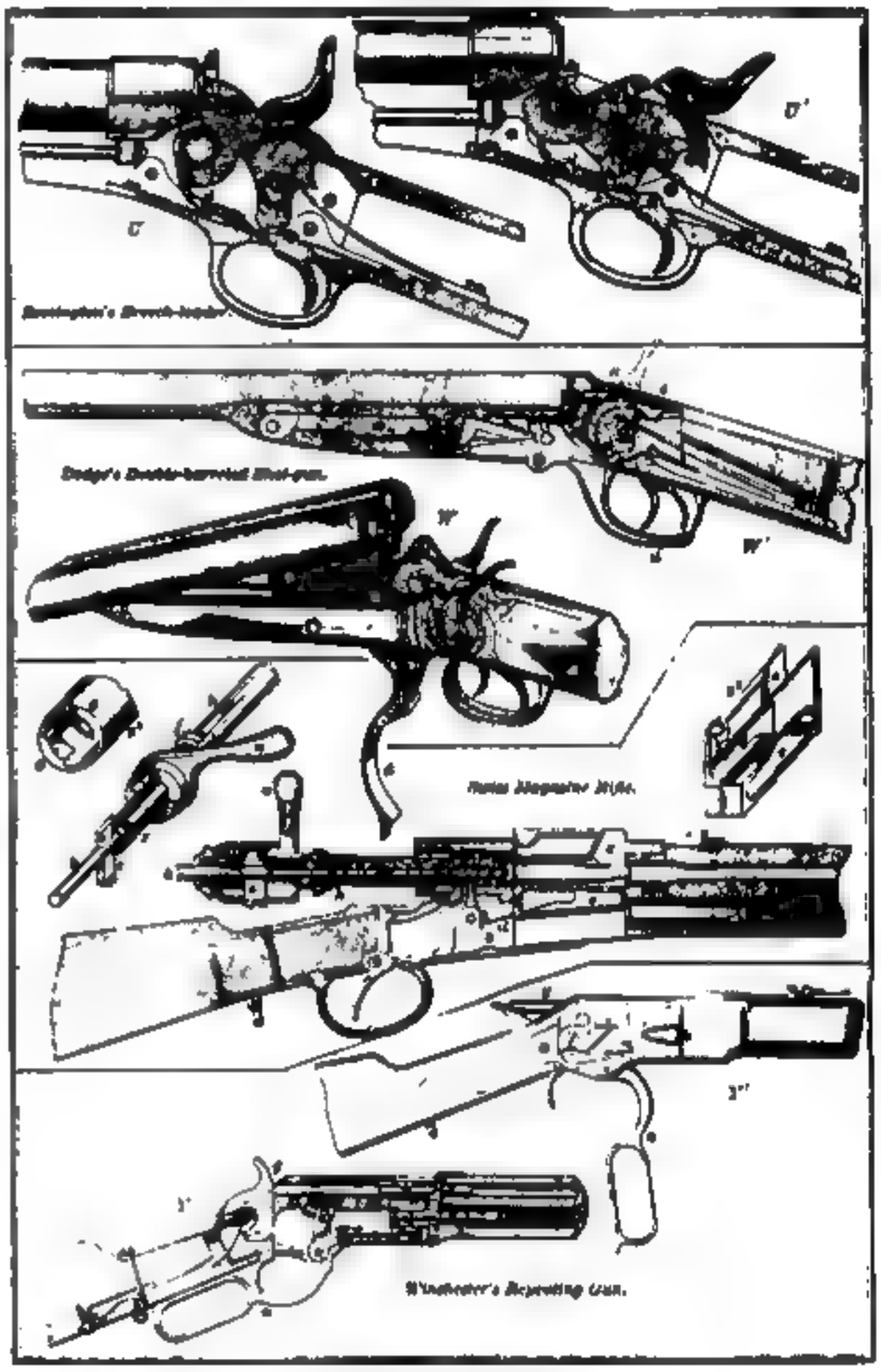


PLATE XVII. BREECH-LOADING FIRE-ARMS.
(*American and European.*)

shown at *C*, Plate 14, has been superseded by the *Mauser* gun. See NEEDLE-GUN.

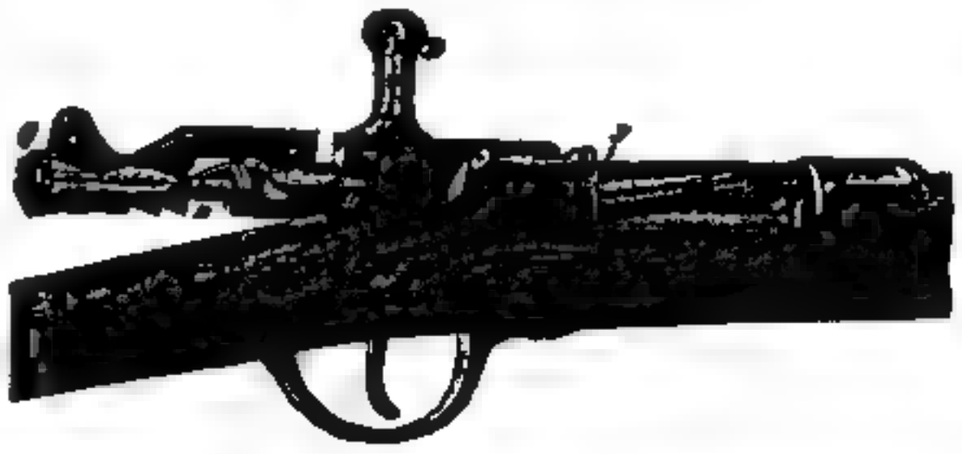
The breech-loaders purchased by the American government between January 1, 1861, and January 30, 1866, were of number and kind as follows: —

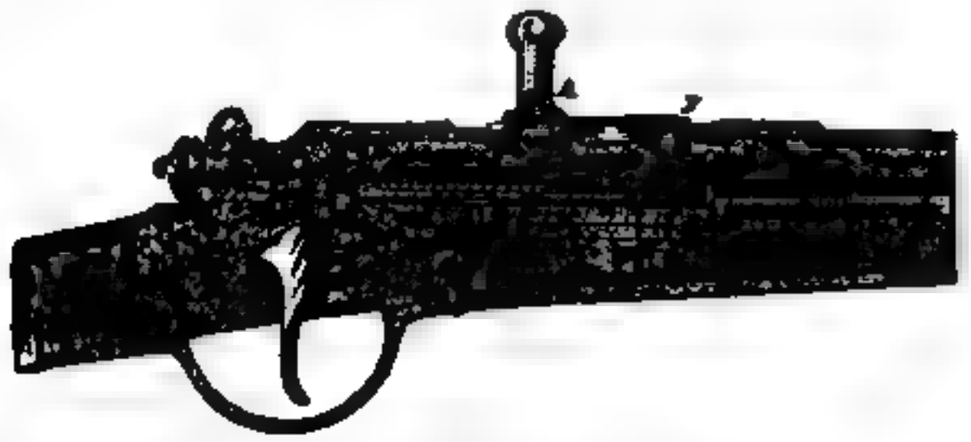
Ballard	1,500	Maynard	20,002
Ball	1,002	Palmer	1,001
Burnside,	55,567	Remington	20,000
Cosmopolitan	9,342	Sharpe	80,512
Gallagher	22,728	Smith	30,062
Gibbs	1,052	Spencer	94,156
Hall	8,520	Starr	25,603
Joslyn	11,261	Warner	4,001
Lindner	892	Wesson	151
Merrill	14,495		

Fire Arm. Fig. 1028 shows the new service gun of Capt. Gras, adopted for the French army.

The upper figure shows the piece in the position as the cartridge is being extracted, and the lower figure as it is ready

Fig. 1028.





The Gras Rifle. The French Service Arm.

to fire. *A* is the movable breech piece operated by the lever. *C* is the dog, at the end of which is a button, to which the rod *D* of the firing pin *E* is attached. *F* is the coiled spring, which throws the pin forward. For loading the gun, the parts are drawn back as shown in the upper figure. The cartridge is inserted and the bolt *A* by the lever *B* is drawn forward. While this is being done, a stop, *G*, enters a cam groove, *H*, in the side of the bolt *A* so that the latter is forced to turn as it is brought forward In the lower figure it will be noticed that the notch on the dog *C* is almost in contact with the spring stop *I* governed by the trigger. By pulling on the latter, this stop is withdrawn, and the needle is thrown forward by its spring, striking and exploding the cartridge. At *J* is the extractor, the part containing which, though drawn back, does not turn with the movable breech, so that the spring hook always grasps the rim of the cartridge case from above. With this gun it is stated that 45 shots can be fired in three minutes, effective at a range of 5,120 to 5,440 feet.

Flint-lock. The old-fashioned lock for fire-arms, in which the cock held a piece of flint and came glancing down upon the steel cap of the pan which contained the priming.

Flint-locks were invented early in the seventeenth century, and gradually superseded the match-lock. Pyrites or marcasite was also used. See GUN-LOCK.

For'ward-fire Car'tridge. One in which the fulminate is at or in the base of the ball, forward of the powder. It is exploded by a stem *d*, as in the figure, or else by a needle which penetrates the whole extent of the powder, and strikes the fulminate in the base of the bullet. See NEEDLE-GUN.

Fig. 2082.

Forward-Fire Cartridge.

Fric'tion-pri'mer. A small brass tube filled with gunpowder, and having a smaller tube containing friction composition inserted at right angles near the top. The composition is ignited by means of a roughed wire inserted in the smaller tube, which is rapidly drawn out by a lanyard having a hook at the end.

The composition consists of 2 parts sulphuret of antimony and 1 part chlorate of potassa, moistened with gum water and dried.

Fric'tion-tube. (Ordnance.) A tube containing a composition which is inflamed by friction, and which is placed in the vent of a gun to ignite the charge when the lanyard is pulled. See FRICTION-PRIMER.

Fri'zel. The movable plate of steel placed vertically above the pan of a gun-lock to receive the blow of the *mapliance*. The form of flint-lock which superseded the wheel-lock.

Ful'mi-nate. Beckman states that fulminate of gold was discovered by a monk in the fifteenth century. This substance, which explodes more rapidly and with greater local force than gunpowder, is made by precipitating a solution of chloride of gold by an excess of ammonia. Mr. Forsyth discovered that by treating mercury as the old monk had treated gold, an equally powerful but far less expensive fulminate might be made. This he mixed with six times its weight of niter, and the result is the percussion-powder which, in the form of paste, is used for charging copper caps for fire-arms. In modern practice the proportion of niter has been much reduced.

"Dr. Allen tells me that something made of gold, which they call in chymistry *Aurum Fulminans*, a grain, I think he said, of it, put into a silver spoon and fired, will give a blow like a musquett, and strike a hole through the silver spoon." — PEPYS, 1668

A fulminating powder which explodes when heated to 360° may be made of niter, 3 parts; dry carbonate of potash, 2 parts; sulphur, 1 part.

Fuse. A tube or casing filled with combustible material, and used for igniting a charge in a mine or hollow projectile.

The invention was undoubtedly contemporaneous with that of hollow projectiles.

Blasting-fuse; used in mining and quarrying is filled with a slow-burning composition, allowing time for the operatives to reach a place of safety before it burns down to the charge.

Combination-fuse; for hollow projectiles, comprises a time-fuse and a percussion or concussion-fuse united in the same case.

The former is designed to explode the charge in case the latter fails to act on striking.

Concussion-fuse; for hollow projectiles. Designed to explode the charge when the shell strikes an object.

Electric-fuse. One adapted to be ignited by the passage of an electric spark through it.

Percussion-fuse; embraces a capsule charged with fulminate, which is exploded by a plunger or its equivalent, when the projectile strikes. The plunger is held by a pin sufficiently strong to keep it in place in case of a fall, yet weak enough to be severed by the shock of striking.

Safety-fuse; a cord or ribbon-shaped fuse filled with a fulminating or quick-burning composition, and sufficiently long to be ignited at a safe distance from the chamber where the charge is placed.

Tape-fuse; belongs to the class just mentioned, and is so called from its shape.

Time-fuse; one which is adapted either by cutting off a portion of its length or by the character of its composition to burn a certain definite time.

Fig. 2132, *a b* is the common wooden fuse for shells; the central cavity is filled with a composition of niter sulphur and meaied powder thoroughly incorporated together, and uniformly and compactly driven by means of a mallet and drift. The open end is capped with water-proof paper or parchment.

For use, a part is sawed off at the smaller end. The number of seconds which the remaining composition will burn is indicated by the annular lines, so that cutting off a greater or less portion regulates the time of bursting of the shell. The fuse is inserted in the fuse-hole when the projectile is required for use, and the cap removed previous to loading the piece.

Paper fuses containing compositions which burned at the rate of two, three, four, and five seconds to the inch were formerly employed for field artillery in the United States service. A wooden fuse-plug was driven into the projectile when prepared for ser-

vice, and the fuse inserted therein at the moment of loading. The different kinds were indicated by their color.

These were succeeded by the Bormann fuse *c*, which consists of a flat, circular, screw-threaded piece of an alloy composed of equal parts of tin and lead, having a deep annular channel extending nearly around its lower surface, into which the fuse composition is pressed, communicating with a magazine of fine powder. The composition is protected by an annular piece of the same metal, which is forced down over it by pressure, and turned to a smooth surface. The upper part of the fuse is graduated to quarter-seconds up to five seconds, so that by removing the thin metal covering with a small gouge at any particular mark, the composition, when ignited, will burn the length of time that the mark indicates before reaching the magazine which communicates fire to the bursting charge of the projectile. This fuse rests in part on the walls of the shell and in part on a perforated iron fuse-plug, set in a smaller orifice central to the exterior fuse-hole. When screwed in, it is cemented to the shell by white lead ground in oil, rendering its extraction somewhat difficult and dangerous. To obviate this a modification has been contrived consisting of a flat ring which contains the composition inserted into an annular groove surrounding the hole through which powder is poured into the shell. As this may be made smaller than the ordinary fuse-hole, the efficacy of the bursting charge for shattering the shell is increased, while the charge may be removed without disturbing the fuse; thus greatly lessening the danger of accidents, when it is desired to remove the powder. This form also admits of longer burning fuses than the original Bormann.

Brass fuses having a crooked channel to prevent the entrance of water between the exterior priming and the fuse composition are also employed, more particularly in the naval service.

The English Boxer fuse has a main channel for the fuse-composition, and two smaller channels filled with mealed powder communicating therewith and with each other. Holes corresponding to the lengths required to burn various times are bored from the exterior of the fuse-case to these, and filled with pipe-clay, which is removed from the proper hole when the projectile is inserted into the gun.

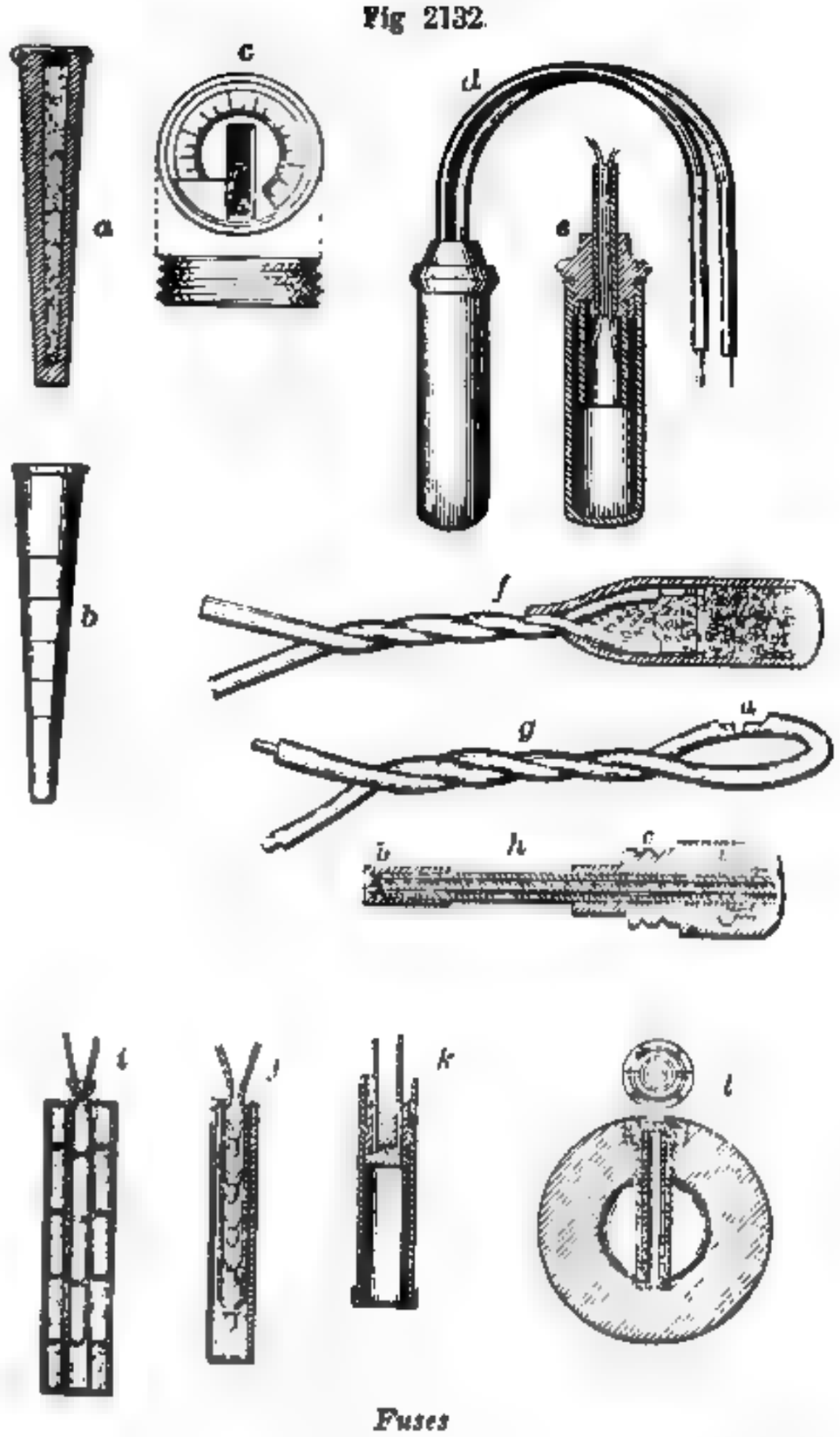
Powel's fuse *l* (Fig. 2132) admits of being turned within the plug, which is screwed into the shell so as to bring corresponding apertures in the fuse and the plug into communication. These are so adjusted to each other that the composition may be made to fire the bursting charge at the expiration of a greater or less number of seconds.

Fuses on this principle have been combined with the percussion-fuse, constituting the *combination* fuse.

Previous to the introduction of rifled cannon and elongated projectiles, a number of attempts had been made to produce a fuse adapted to spherical projectiles which would explode on striking.

One of these, of Prussian origin, was composed of a glass case containing strong sulphuric acid, and wrapped with cotton wick soaked in a composition of chlorate of potash and flowers of sulphur, with pulverized white sugar and alcohol added to give consistency. This was capped with a leaden breaker, which projected beyond a paper case in which the

Fig 2132.



Fuses

tube and wrapper were enclosed, and the whole inserted within a fuse-case partially filled with hard driven mealed powder. This was ignited on firing, and soon burned away, leaving the glass tube unprotected, so that the weight of the breaker would cause it to be shattered on striking an object, setting fire to the wrapper, which in turn exploded the bursting charge.

Splingard's Belgian concussion fuse contained a conical tube of plaster of paris closed at top surrounded by ordinary fuse-composition, which in burning left the tube unsupported, allowing it to break when striking, so that the fire should communicate directly with the charge.

Fuses which explode by percussion or concussion present no difficulty when employed with elongated projectiles for rifled guns, which strike point foremost; and a variety of such, differing slightly in details of construction, have been successfully employed.

Bickford's fuse, English patent, 1831, was specially intended for miners' use.

It consists of a cylinder of gunpowder or other explosive matter covered by a double layer of cord and varnished. A similar fuse covered with a waterproof composition was designed for submarine blasting.

In electric fuses the heat necessary to fire the charge is imparted either by the passage of the current through a fine wire, usually platinum, or through a chemical mixture rendered conducting by

containing a salt of copper. *f* illustrates one of the former, in which the gutta-percha covering is removed from the ends of the conducting wires, which are connected by a fine wire of platinum; these, with the charge of fine grained powder, are enclosed in a water-tight envelope of gutta-percha. *g* is one of the second class, known as Statham's. Its operation depends on the fact that a copper wire covered for some time with vulcanized rubber becomes coated with a layer of sulphide of copper, which is a moderately good electric conductor. This is utilized by twisting a piece of rubber-covered wire so as to form a loop, when part of the covering is removed as shown at *a*, and the wire severed. Consequently, when a spark is passed along the wire, on reaching this spot it must follow the film of sulphide adhering to the rubber; and the resistance which it has to overcome causes the sulphide to ignite.

i j k illustrate Shaffner's blasting fuses and cartridges. *i*, a hollow cartridge provided with central and diverging spaces occupied by a series of fuses and loose nitro-cotton, the whole covered with a water-proof casing into which the ends of the conducting wires pass.

j. The main wires which pass to the mine or cartridge are connected by smaller wires to the fuses, a number of which are placed in a single charge of explosive material.

k is provided with a wooden head enclosed in an indented cylinder closed by a cap; the head has a recess for the fuse composition, and another for the non-conducting cement which surrounds the wires where they enter the head.

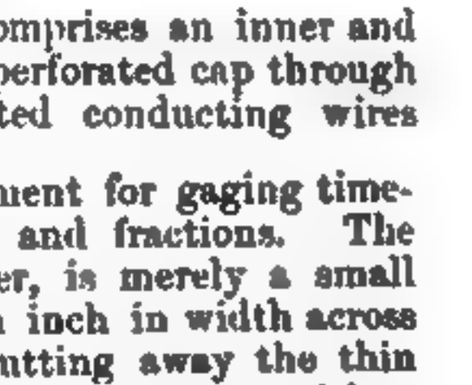
h is the Abel fuse. This consists of a wooden head having a central longitudinal opening and two parallel transverse ones. Through the former two insulated conducting wires are passed, the ends *b* of each being cut off smooth at some distance from the head, and covered with a tin-foil cap containing priming. The gutta-percha is removed from the other ends of the wires, and they are inserted and secured in the two transverse holes before mentioned. When required for use, a case containing fine grained powder is fitted over the shoulder *c* and secured by twine.

Bishop's electric fuse *d e* comprises an inner and outer cylinder protected by a perforated cap through which the separately insulated conducting wires pass.

Fuse-cut'ter. An implement for gaging time-fuses to the desired seconds and fractions. The Bormann, or metal-fuse cutter, is merely a small gouge; about one tenth of an inch in width across the blade, and is used for cutting away the thin shell of metal which overlies the fuse-composition. The cutter for paper fuses for rifled guns, which necessarily are required to burn much longer, is more usually called a fuse-gage. It is a block of wood with a graduated brass gage let into one side, and having a hinged knife working on the same side, like a tobacco-knife, by which the fuse, which is marked on the side to seconds and fractions, is cut off so as to burn any required length of time.

Fuse-lock. For miners. A spur on the spring attaches the lock to the fuse when the hammer is set. The dog is pulled by a long cord from a distant position of safety, releasing the hammer, which explodes the cap and lights the fuse.

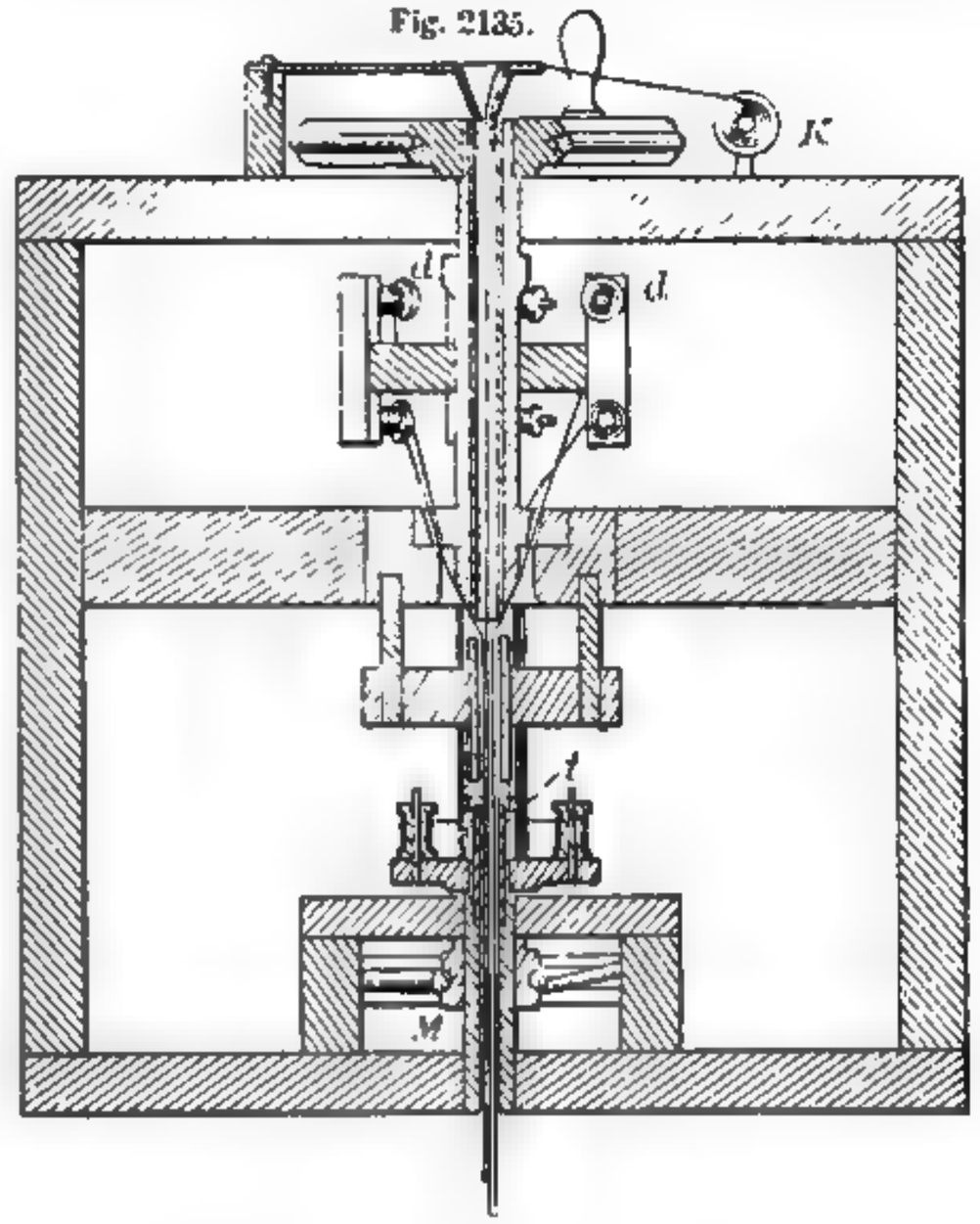
Fig. 2134.



Fuse-Lock.

Fuse-mak'ing. A machine having a vertical rotary shaft through which the powder descends around a central cord delivered from the spool *K*. Threads from the spools *d d*, etc., placed on a rotating frame, are wound about it as it descends, forming a twofold covering, which is compacted around the composition as the fuse passes through the ring *t* at the upper part of the slotted shaft *M*.

Fig. 2135.



Fuse-Making Machine.

Fuse-saw. A tenon-saw used by artillery-men.

Fuse-set'ter. An implement for driving home wooden fuses. It consists merely of a cylinder of wood or brass, with a recess at the end fitting the end of the fuse, which is driven into place by a mallet.

Fuse-tape. A flat form of fuse, coated externally with pitch or tar, and *served* to prevent the coating from cracking, or covered with two warps and an interposed lap of cotton. Other forms might be noticed.

Fu'sil. A light fire-arm or musket of an antiquated pattern.

— G —

Gar-rote'. A Spanish instrument of execution. The victim is fastened by an iron collar to an upright post, usually in a sitting posture, and a knob operated by a screw or lever dislocates the spinal column, or a small blade severs the spinal cord at the base of the brain.

Gas Check. A ring at the rear of the chamber of a cannon which prevents the escape of gas rearwardly in breech-loading guns. Also known as an *obturator*.

Gla'zing Bar'rel. (*Powder Making.*) A revolving barrel in which powder is glazed with graphite. A barrel holds 400 pounds and makes 40 revolutions per minute, an addition of 0.5 oz. of graphite being made for each 100 lbs of powder. 40 minutes is required for each charge.

Grad'u-a'ting Sight. (*Fire-arms.*) One graduated for distance, wind, etc. See VERNIER SCALE SIGHT, for the former; WIND GAGE SIGHT, for the latter.

Gran'u-la'ted Wood Pow'der. The invention of Captain Schultze, of the Prussian army.

Wood is sawed into fine veneers across the grain. These veneers are chipped into small cubes. The acids and soluble substances are removed, and the little cubes are treated with a mixture of 40 parts by weight of nitric acid (of 1.48 to 1.51) and 100 parts sulphuric acid (of 1.85), and set aside to cool. Six parts of wood is added to 100 parts of the acid, stirring constantly for 8 hours. The grains are dried in a centrifugal machine, washed in running water, boiled in a weak solution of carbonate of soda; again washed and dried. The grains are then heated with potash or baryta nitrate, dried at a temperature of 90° to 112° Fah. for 12 hours.

Gran'u-la'ting Ma-chine'. (*Gunpowder Making.*) The granulating machine works upon the broken pieces of powder cake, to reduce them into the proper size of grains.

It consists of two bronze side frames supporting four pairs of bronze toothed rollers placed on different levels and having their axes parallel and horizontal.

The first set is at the top of the machine, about 20′ from the floor, and the press cake, broken up between them, falls on to an inclined screen which conducts the fragments to a second pair of rollers. A succession of vibratory screens sorts the powder into grades and dust.

In the Petersburg arsenal the powder cake is broken into grains by placing it in sieves which contain a certain number of bronze balls. These sieves are attached to a vibratory frame, crushing the cake, the pieces falling through the bottom of the sieve into drawers beneath. The grains are subsequently dusted, glazed, and assorted.

Grape-shot. Spherical iron shot rather less than half the diameter of the bore of the piece for which they are intended, and put up in *stands* consisting of three tiers of three shot each; the stand has a circular cast-iron plate at top and bottom connected by a bolt and nut; two rings bind the tires together and keep them in place. Grape-shot are now little used, except with guns of the larger calibers, from 24-pounders upwards.

Fig. 2300.

Grape-Shot.

Quilted grape are formed by sewing the shot up in a sort of canvas bag, which is afterwards wrapped around with twine or cord, so as to form meshes; musket bullets put up in this way were formerly employed for blunderbusses, wall-pieces, and small artillery.

Greek-fire. An incendiary composition used in early times by the Tartars, and afterwards by the Greeks.

The invention is ascribed to Collinicus, an architect of Heliopolis, the "city of the sun," afterwards called Baalbec. He is reported to have deserted the service of the Caliph and entered that of the Emperor Constantine Pogonatus, A. D. 673. The Emperor Leo described its use, 911; the Princess Anna Comnena described its properties, 1106; so did Joinville, 1249.

In two sieges, writes Gibbon, the deliverance of Constantinople may be chiefly ascribed to the novelty, the terrors, and the real efficacy of the Greek-fire. It was poured from large boilers on the ramparts, or launched in hollow balls of metal, or darted with arrows and javelins, twisted round with flax and tow which had imbibed the inflammable oil. In naval battles, fire-ships filled with these combustibles were carried by the wind, that fanned their flames against the sides of the enemy's vessels. It was usually blown through long copper tubes, planted in the prow of a galley, and fancifully shaped into the mouths of savage monsters that seemed to vomit a stream of liquid fire. The art of compounding it was preserved at Constantinople as the palladium of the state. Its galleys and artillery might occasionally be lent to the allies of Rome, but the secret of the Greek-fire was concealed with the most jealous scruple for above four hundred years. The Princess Anna Comnena, in mentioning resin, sulphur, and oil as its components, only intended, it is probable, to baffle curiosity by telling just so much as everybody knew already.

In 1098, the fleet of Alexis Comnenus used Greek-fire against the Pisans. His ships had "siphos" fore and aft, in form of syringes, which squirted the inflamed matters.

It is believed that the ancient Byzantium was marked by the present walls of the Seraglio. Constantine enlarged it A. D. 328, gave it its name, and made it the rival of Rome. It was taken from the Greeks, in 1204, by the Venetians under Dandolo; retaken by the Greeks, in 1261, under the Emperor Michael Palæologus; captured by the Turks in 1453.

An old recipe for Greek-fire is thus given: —

"Aspaltum, nepta, dragantum, pix quoque Graeca,
Sulphur, vernicis, do perollo quoque vitro.
Mercurii, sal gemmae Graeci dicitur ignis."

Another reads as follows: "Take of pulverized resin, sulphur, and pitch equal parts; one fourth of oppopanax and of pigeons' dung well dried, dissolved in turpentine water or oil of sulphur; these put into a strong, close, glass vessel and heat for 15 days in an oven; after which distill the whole in the manner of spirits of wine and keep for use."

The contact of water would increase the violence of this villainous compound.

The savans of the Middle Ages were well acquainted with a number of explosive mixtures, some of which were especially effective by the liberation of poisonous gases which asphyxiated the enemy. In effect like our modern stink-balls, but not thrown, like the latter, from a gun or mortar, but projected by squirts or in bottles, after the manner of a hand-grenade. Prester John, who seems to have combined regal and sacerdotal powers somewhere in Tartary about the eleventh century (some say the thirteenth), is cited as particularly skilful in blowing up his enemies. He stuffed — so says the legend — copper figures with explosive and combustible materials which were emitted at the mouths and nostrils of the effigies, making great havoc.

The Danish historian, Saxo Grammaticus, A. D. 1200, gives an account of a similar contrivance, used by a Gothic king. The devices of Archimedes, who defended Syracuse from the Romans, 212 B. C., were mechanical or optical, and do not seem to have involved chemical compounds.

Gre-nade'. (Italian *grenado.*) A small shell weighing about two pounds, and thrown by hand. It is said to have been first used at the siege of

Wacklindonck, near Gueldres. The right company of each battalion was formerly composed of the taller men armed with hand-grenades. Hence the term *grenadiers*. Various forms of grenades have been invented, some containing combustibles, missiles of various sorts, Greek-fire, or other incendiary compounds. 6-pounders, and even larger shells, have been used as rampart grenades, being rolled over parapets against assailants.

The Orsini grenades, with which an attempt was made to assassinate Louis Napoleon, were spherical shells containing powder and missiles, and having a large number of cones or nipples, each capped with a gun-cap. They were made in London.

Guil'lo-tine. A machine for beheading persons, named after Joseph Ignace Guillotin, a French physician (1738 – 1814), its supposed inventor. He did not invent it, but seeing that his Revolutionary friends had a large job of killing on hand, he suggested its use as a certain and complete mode of decapitation.

Dr. Antoine Louis, of Paris, had the credit of its invention for a while, and it appears under the hands of the facile French to have attained a completeness in construction and execution which left nothing to be desired — except, perhaps, mercy.

A beheading machine, called the *maiden*, and sometimes the *widow*, by the *lively* Scotch, was imported from Halifax, England, into Scotland, about 1550, by the Regent Morton, who seems to have been enamored of the maiden's business capacity. He was beheaded thereby in 1581, — though he was not the first victim, as has been sometimes stated. The murderers of Rizzio were beheaded by it in 1566; and among its last victims was the Earl of Argyle, 1681.

It is laid up as a memorial in the Museum of the Scotch Society of Antiquaries, Edinburgh.

Of the Halifax machine we know but little except that Morton imported the maiden thence.

Pursuing the back track, we find that the Duc de Montmorenci (blue blood) was executed by a falling axe at Toulouse, 1632; that the Dutch used it in executing slaves in their colonies, and that its use was comparatively common in Germany during the Middle Ages.

The *Mannaia* of Italy, by which Conradin of Swabia was executed, 1268, at Naples, and Beatrice Cenci at Rome, in 1605, was of the same construction substantially.

The guillotine is mentioned in German books of 1534, 1551, and 1570. It is called the Roman falling-axe, and the decollation of St. Matthew thereby was a favorite subject with illuminators of manuscripts 250 years before the French Revolution.

In the London "Monthly Magazine," April 1, 1800, p. 247, is an enumeration of ten cuts and engravings of the sixteenth century in which a guillotine is employed. The representations are principally martyrdoms of saints.

During the war of the Spanish Succession, 1702 – 13, Count Bozelli was decapitated by the guillotine, which is thus described by a traveler who witnessed the act: —

"In the great square was erected a scaffold, covered with black. In the middle of it was placed a great block of wood, exactly of such hight that the criminal, on his knees, could lay his head upon it, between the pillars of a sort of gallows, which supported an axe of a foot in hight and a foot and a half in breadth, sliding in a groove. The axe had a mass of above a hundred weight of lead attached to its upper side, and was suspended by a cord fastened to the gallows. The executioner cut the cord that supported the axe. The deadly instrument in its fall severed the head from the body, and penetrated about two inches into the block."

The original instrument was probably Persian.

The French *guillotine* has a heavy knife, sliding in vertical grooves in a frame.

It is a grim subject, but, involving mechanical construction, is within our scope.

An observer in Paris thus records the appearance of the machine and the mode of using it: —

"On a platform about 12 feet square, and 7 feet above the ground, are erected the two upright posts between which is suspended the axe. They somewhat resemble a narrow gallows with not more than a foot between the posts. The axe, which is not unlike a hay-knife, though much heavier and broader, is drawn up to the top of the posts, between which it runs in grooves, and is held suspended by a loop in the halyards, passed over a button at the bottom. The edge of the axe is diagonal, so as to make a *draw* cut, giving it a fearful power and certainty in severing a human neck.

"On the center of the platform stands a frame or large inverted box, much resembling a soldier's arms-chest, about 6 feet long and 2½ feet wide and high. One end of this abuts upon the upright posts; at the other end is a small truck having a strap and buckle by which the culprit is secured to it.

"The victim was advanced with his breast against the truck, to which his body was rapidly strapped. He was then tilted down, truck and all, upon his face; the truck, moving upon small wheels in grooves on the top of the chest, was run rapidly forward until the neck came under the knife. The rope was unhooked from the button, the axe fell with a *thud*, the head fell into a basket, and the body was unstrapped and rolled into a large basket alongside."

Fig. 2335.

Guillotine.

There is an air of ferocity about the punishment by beheading, and of absolute brutality in the mode of execution by hanging. The Japanese are skillful decapitators. The Spanish garotte is a horror. Poisoning is ancient but disreputable. Shooting is martial, and has one merit; it enables a man to stand up and face the executioner, and has less of humiliation than the cutting and choking processes.

It is a vulgar error that Dr. Guillotin perished by the machine of his suggestion. He died in 1814, after founding the Academy of Medicine.

The myth seems to have been derived from the Regent Morton's having been beheaded by his imported pet. This kind of poetic justice is commoner in tradition and romance than in fact. It seems to round up

and complete the history when —

"This even-handed justice
Commends the ingredients of our poisoned chalice
To our own lips."
"Where the offence is let the great axe fall."

Gun-bar'rel. Gun-barrels of superior quality are known as *stub*, *stub-twist*, *wire-twist*, *Damascus-twist*, *stub-Damascus*.

Stub-iron consists of horseshoe nails, cleaned in a tumbling-box, mixed with from 12 to 50 per cent of steel pieces of the same size; puddled, hammered, heated, tilted, and rolled. From this material a *skelp* is made.

Twist barrels are made of a ribbon of iron wound spirally around a mandrel and welded.

Stub-twist is stub-iron coiled on a mandrel, as described.

Wire-twist is made by welding laminæ of iron and steel together, or two qualities of iron, and drawing the compound bar into a ribbon, which is coiled as described.

Damascus-iron is made of several bars of steel and iron laid parallel in a *fagot* and drawn out into a bar. A piece of the bar is heated to redness, one end placed in a vise and the other end grasped by tongs, by which the bar is twisted till it assumes a cylindrical shape, and is shortened to, say, three feet. Several such bars, twisted in diverse directions, are laid together, welded, and drawn into ribbons, which are severally wound on mandrels as before.

Stub-Damascus is formed from a single bar or twisted rod, forged, drawn into a ribbon, and wound on a mandrel.

Damascus and wire twist is ribbon of the said varieties combined.

The ribbon for the twisted barrel is several yards long, about ½ inch broad, and is thicker at one end than the other, in order to give the strength at the breech. It is heated to redness, coiled around a mandrel, the coil removed, heated to welding heat, dropped on to a cylindrical rod which is then struck vertically on the ground to jar the edges of the spiral together and cause them to adhere. This is called *jumping*, and the operation of welding is completed by a hammer on an anvil, the central rod being maintained in position.

The iron plate, technically termed a *skelp*, is usually about a foot in length, and when heated to a welding temperature is rolled around a mandrel and passed through sets of rollers, which, in turn, elongate the skelp, reducing its diameter and giving the proper size and taper to the barrel.

Formerly the edges of the heated blank were welded upon the mandrel by the successive blows of a trip-hammer, or a "drop," dies intervening between the iron tube and the drop and anvil respectively. A portion only of the seam is closed at a time by this means, and the operation is more tedious and expensive than the rollers just described. The rolling process was introduced from England.

(*Boring.*) For boring, the barrels are placed in a heavy iron frame called "boring banks," where they are reamed out by the boring-tool, which consists of a square broach of steel, with sharp edges. The tool is rotated and advanced while the barrel is firmly held, and the operation is repeated with successively larger tools until the required size is obtained, — something short of the eventual caliber, as other operations are to follow, and will farther increase the size of the bore.

The outer surface of the barrel is then turned in a lathe, the barrel being sustained by mandrels at each end. The tool may be fixed in a slide-rest which moves it longitudinally of the barrel, and also in or out to give the required taper from the breech to the muzzle, or the latter or transverse motion may be imparted to the tool-rest while the barrel has a longitudinal in addition to its rotary motion.

The barrel is then ground by being held parallel to and against the face of a rapidly revolving stone. For this purpose the barrel is slipped upon an iron rod and revolved by means of a crank on the end of the rod. The stones are cased in for safety, and also to keep the water from splashing upon the workmen, holes in the ends of the casing permitting the introduction and withdrawal of the barrel.

After grinding, the barrels are polished by hardwood rubbers, supplied with lard-oil and emery. The barrels are placed in upright frames, several in each frame. The grooved ends of the rubbers are then pressed by springs against the barrels as they move up and down with a regular and rapid motion, the barrel, the while, revolving slowly. After remaining in the first polishing-machine for fifteen minutes or thereabouts, they are transferred to another and similar apparatus where the emery is dispensed with.

Much ingenuity has been expended in devices for detecting deflection or faults in gun-barrels, and for straightening them when unevenness is detected. The correction is made by placing the barrel on a small anvil and giving it a gentle blow with the hammer. The workman obtains artificial aid in detecting faults, by a transparent slate marked with two parallel lines and placed in a window. The barrel being pointed towards the window, the lines are reflected upon the polished interior surface of the barrel, and any unevenness throws the reflected lines out of parallelism; which is readily detected by the experienced workman. In former times, a hair or some other very slender line was passed through the barrel and drawn successively across each portion of the inner surface, concavities being revealed by the distance between the line and its reflected image in the metal.

For proving, the barrels are loaded with a heavy charge and then laid in a rank in the parallel grooves of a massive table in the proving-room, the charge in each piece being connected to a train of powder on the back of the stand, and passing to the outside of the building, so as to fire the charges from a place of security. The balls are received in a bank of earth, and those barrels which appear to have withstood the first charge are subjected to a second, smaller proving charge, to open any rent which may have been made by the former. Those which stand both tests are stamped with the mark of approval.

A still more severe test is filling the barrel with water, and driving in an air-tight bullet by heavy and repeated blows. If any chink or crack is to be found, the water will ooze from it.

The barrel having been welded, rolled, bored, turned, ground, polished, and proved, is now to be rifled by having twisting grooves cut in its interior. This is more fully referred to in this work under RIFLING-MACHINE, and is a very old device, specimens of rifled cannon and small-arms of the seventeenth century being preserved in European collections. In general features most of the machines agree; the barrel is firmly secured in the frame of

the machine, and the grooves on its inner surface are cut by narrow bars of steel, which are placed within three apertures near the end of an iron tube which passes through the barrel by a slow compound motion, rotary and progressive.

The sight and cone seat are attached to the barrel at the proper stage of its progress, the former by brazing and the latter by welding.

Steel barrels are drawn from short bars, which are bored, heated, and drawn upon a mandrel between rolls, which successively lengthen and reduce the diameter of the barrel.

After boring and rifling, the grain or mottled appearance is produced by steeping in acids or by heating in boxes with charcoal, and then plunging in solution of ammonia. See BROWNING.

The principal imperfections to which gun-barrels are liable are the *chink*, the *crack*, and the *flaw*.

The *chink* is a small rent in the direction of the length of the barrel.

The *crack* is an imperfection across the barrel.

The *flaw* is a scale, or small plate, adhering to the barrel by a narrow base, from which it spreads out like the head of a nail from its shank, and when separated leaves a little pit in the metal which collects moisture and foulness, corroding the metal.

Gun-barrel Gage. The gage of large guns is the weight of the ball they carry, as 6-pounder, 8-pounder, 12-pounder, etc.

Or it is expressed in inches, and the fraction, if such there be, in decimals, as 8-inch, 10-inch.

The bore of the barrels of fire-arms is also denominated by the decimals of an inch, as .44, .45, .50, .55; all of which are somewhat common sizes.

The usual mode of denominating the barrels of sporting-rifles and fowling-pieces is by the number of bullets, of the diameter of the bore, that are contained in one pound of lead.

Gage-Table for Barrels of Fire-Arms.

No	Diameter of Bore in 100ths of 1 Inch.	Weight of Leaden Bullet in Grains.	No.	Diameter of Bore in 100ths of 1 Inch.	Weight of Leaden Bullet in Grains.
5	.98	1,400	19	.65+	368$\frac{8}{19}$
6	.93−	1,666$\frac{2}{3}$	20	.63+	355
7	.89	1,000	21	.63	333$\frac{1}{3}$
8	.85−	875	22	.62+	318$\frac{2}{11}$
9	.81−	777$\frac{7}{9}$	23	.61+	304$\frac{4}{23}$
10	.79	700	24	.61	291$\frac{2}{3}$
11	.77−	636$\frac{4}{11}$	25	.60+	280
12	.75+	583$\frac{1}{3}$	26	.59+	269$\frac{3}{13}$
13	.74−	538$\frac{6}{13}$	27	.59	259$\frac{7}{27}$
14	.72−	500	28	.58+	250
15	.70+	466$\frac{2}{3}$	29	.58−	241$\frac{14}{29}$
16	.69−	437$\frac{1}{2}$	30	.57	233$\frac{1}{3}$
17	.67+	411$\frac{13}{17}$	31	.56+	225$\frac{24}{31}$
18	.66	388$\frac{8}{9}$	32	.56−	218$\frac{3}{4}$

Gun-carriage. The apparatus upon which a cannon is mounted for service. It may or may not be adapted for the transportation of the piece.

The first consisted merely of a timber-block, or frame, to which the cannon was secured by straps or bolts. Uprights, with holes for pegs, were sometimes employed to give elevation to the muzzle. Afterwards a species of trough, having a butt-piece and mounted on wheels, was introduced (*A*, Fig. 2339). Subsequent improvements brought them nearly to the form *B*, which represents a carriage of the Gribeauval pattern. Gribeauval, a French artillery officer, made great improvements, 1765, in gun-carriages and the organization of artillery, reducing the size of the parts, and making the similar parts, for those of the same class, interchangeable; he also added a tongue, so that two horses could draw abreast, and made the limbers so that one sort would answer for several different kinds of carriages.

Land gun-carriages comprise field, siege, casemate, and barbette carriages. The two former are adapted for the transportation as well as service of the piece, while the latter are intended to be kept in one position in a fortification. A smaller kind of field-carriage may be readily taken to pieces and put together, so as to be carried on mules' backs in a rugged and mountainous country.

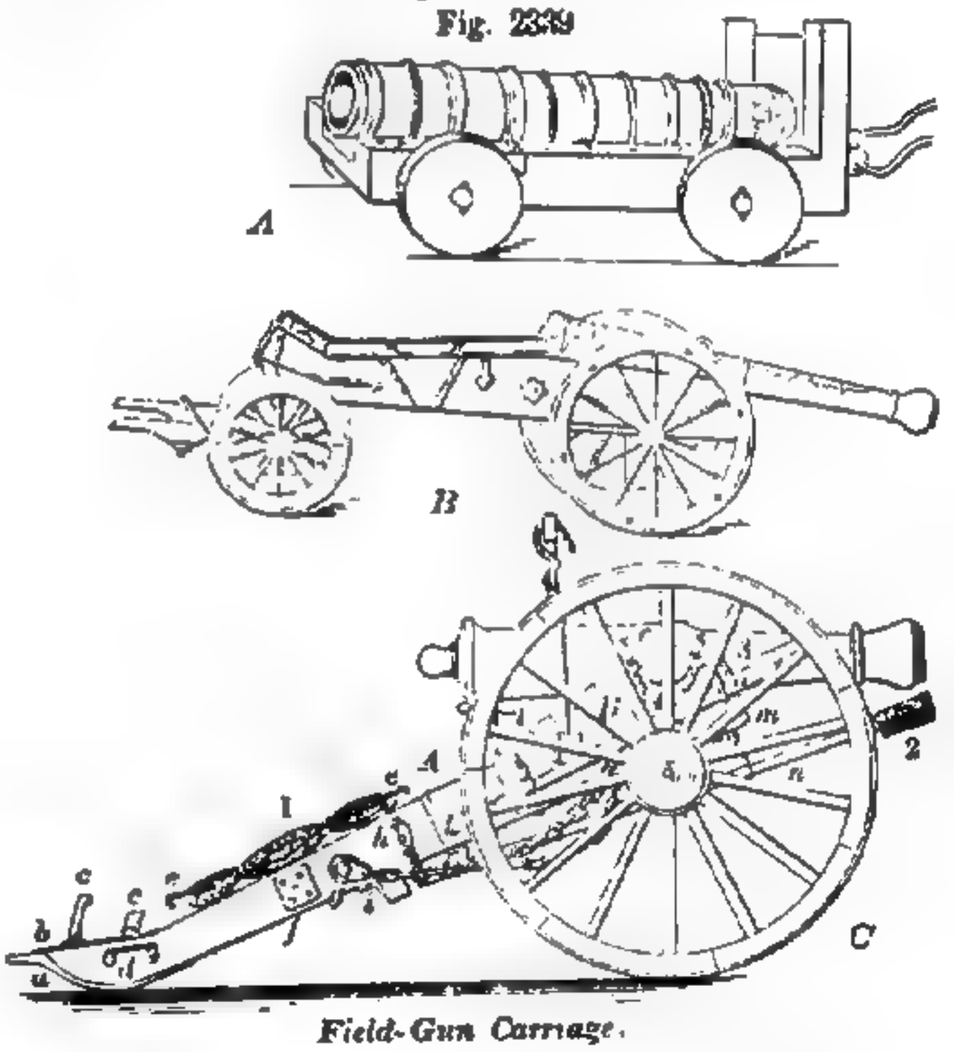
Field-carriages include those which are adapted to accompany the movements of troops during an engagement, and carrying a class of guns weighing from 800 to 1200 pounds, as the 12-pounder smooth-bore and lighter rifled cannon.

These carriages are known as "stocktrail" pattern, from having a single piece, which serves as the trail, inserted between the two cheeks on which the trunnions rest.

The Gribeauval and older patterns of carriage had no stock, the ends of the cheeks resting immediately on the ground; the fore-wheels were also smaller than the hinder.

C is an elevation of a field-gun carriage without its limber. The various parts are, —

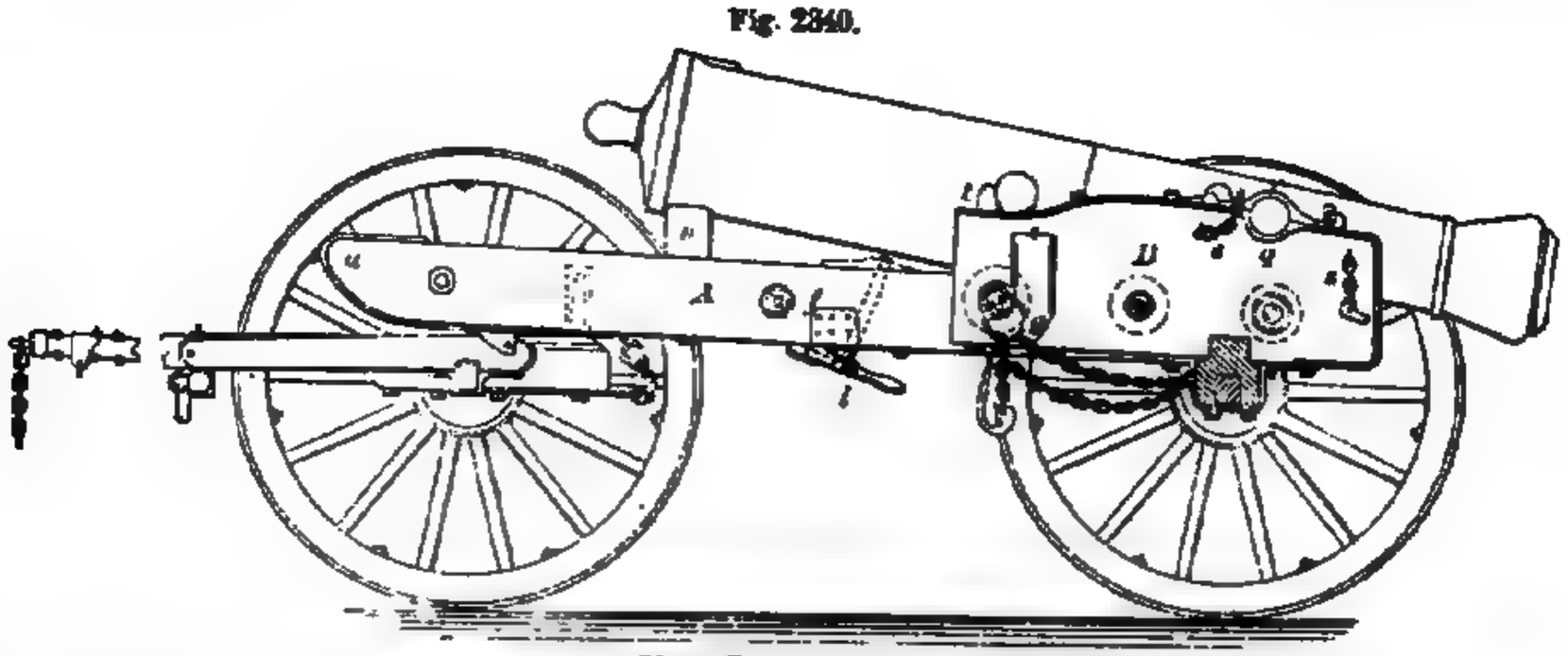
Fig. 2339



Field-Gun Carriage.

A, stock.
B, cheek.
a, lunette.
b, trail-plate.
c c, pointing rings.
d, handle.
e e, prolonge hooks.
f, wheel-guard plate.
g, lock chain, bolt, nut, and washer.
h, turn-buckle, chain, and hasp for sponge and rammer.
i, stop for rammer-head.
k, ear-plate for worm.
l, elevating-screw.
m, under-strap.
n, implement-hook.
o, D-ring for hand-spike.
q, trunnion-plate.
r, cap-square.
s, cap-square chains and keys.
1, prolonge.
2, sponge and rammer.
3, hand-spike.

Fig. 2340.



Siege-Gun Carriage.

The detachable forepart of the carriage is called the limber. It carries a chest for containing ammunition, upon which the cannoniers sit. The limbers for all field-carriages differ only in the interior fitting up of the chest, adapting it for receiving different kinds of ammunition.

A *caisson* for carrying ammunition accompanies each field-piece. This vehicle has a limber similar to that of the gun-carriage. Its rear part, or body, carries two ammunition-chests, the three, with that on the carriage-limber, containing the full supply of ammunition for the piece.

Each field-battery of four or more pieces is also accompanied by a *traveling-forge* and a *battery-wagon*, which contain the necessary tools and materials for ordinary repairs.

Each carriage is drawn by six horses, harnessed in a manner somewhat different from the ordinary way, the traces of the wheel horses being directly attached to the splinter-bar of the limber, and the traces of the leaders connected to those of the wheel-horses. Swingletrees and whiffletrees are thus dispensed with.

The siege-carriage (Fig. 2340), though larger and heavier than that for field service, differs little from it in general construction. For transportation the gun is moved backward, the trunnions resting against the head of the traveling trunnion-bolt *t*, the breech supported on the bolster *u*. The small parts for holding the implements are wanting.

Three sizes are employed in the United States artillery service, one for the 4½-inch rifled gun, one for the 18-pounder smooth bore and 30-pounder rifled gun, and one for the 24-pounder and 8-inch howitzer.

Barbette carriages are intended for firing over the parapet of a fortification, and are adapted to mount guns of 32-pounder, 8-inch, 10-inch, 15-inch, and 20-inch caliber. The carriage proper rests on a frame called the *chassis*, which turns about a fixed pintle, so that it may be traversed to point wholly or partially around the circle. See BARBETTE.

Casemate carriages resemble the above in their general construction, but are somewhat less high in proportion. They are placed in casemates, where the gun is fired through an embrasure. See CASEMATE.

These two latter classes of carriages, and also mortar beds, have since 1860 been made of wrought-iron, which material has also been tried to some extent for field-carriages with a promise of good results. Cast-iron was at one time tried and found utterly unsuitable.

Ordinary broadside naval gun-carriages much resemble the army casemate carriage, but have no chassis. They are mounted upon four small wheels, called "trucks," and are run in and out and pointed by means of two *side tackles*, hooked respectively on the left and right to the side of the ship, and a *train-tackle* hooked to a ring-bolt behind the carriage. Excessive recoil is checked by the breeching, a stout rope passing through a hole in the cascabel of the gun, and shackled to the ship's ribs on either side. Elevation is given either by means of a graduated quoin or an elevating screw.

In the *Marsilly* carriage the two front rollers are wanting, the front transom resting immediately on the deck.

Light broadside guns and boat guns have their carriages arranged to run on slides corresponding to a chassis, and have compressors for moderating the recoil. Boat guns are also provided with field-carriages of iron in order that they may be employed on shore.

Heavy pivot guns as 11-inch, on upper decks, are mounted on a peculiar carriage, which enables them to be directed to any point around the circle by means of side tackles and *in* and *out* tackles hooked to bolts appropriately placed around the deck.

Very heavy guns, as 15-inch or 20-inch, being always placed in revolving turrets, their carriages need have no lateral motion, as this is obtained by the rotation of the turret itself, operated by connection with the engine of the ship. Devices similarly operated are also provided for loading. See BATTERY-FORGE, BATTERY-WAGON, CAISSON, BARBETTE-CARRIAGE, CASEMATE-CARRIAGE, MORTAR.

The necessities of modern warfare, land and marine, have given rise to many inventions for operating heavy guns and for the protection of those working them. For the latter purpose, besides mantelets and shields, arrangements have been made for rotating the turret in which the gun is mounted so as to cover the embrasure; depressing the gun during loading below the embrasure, etc.

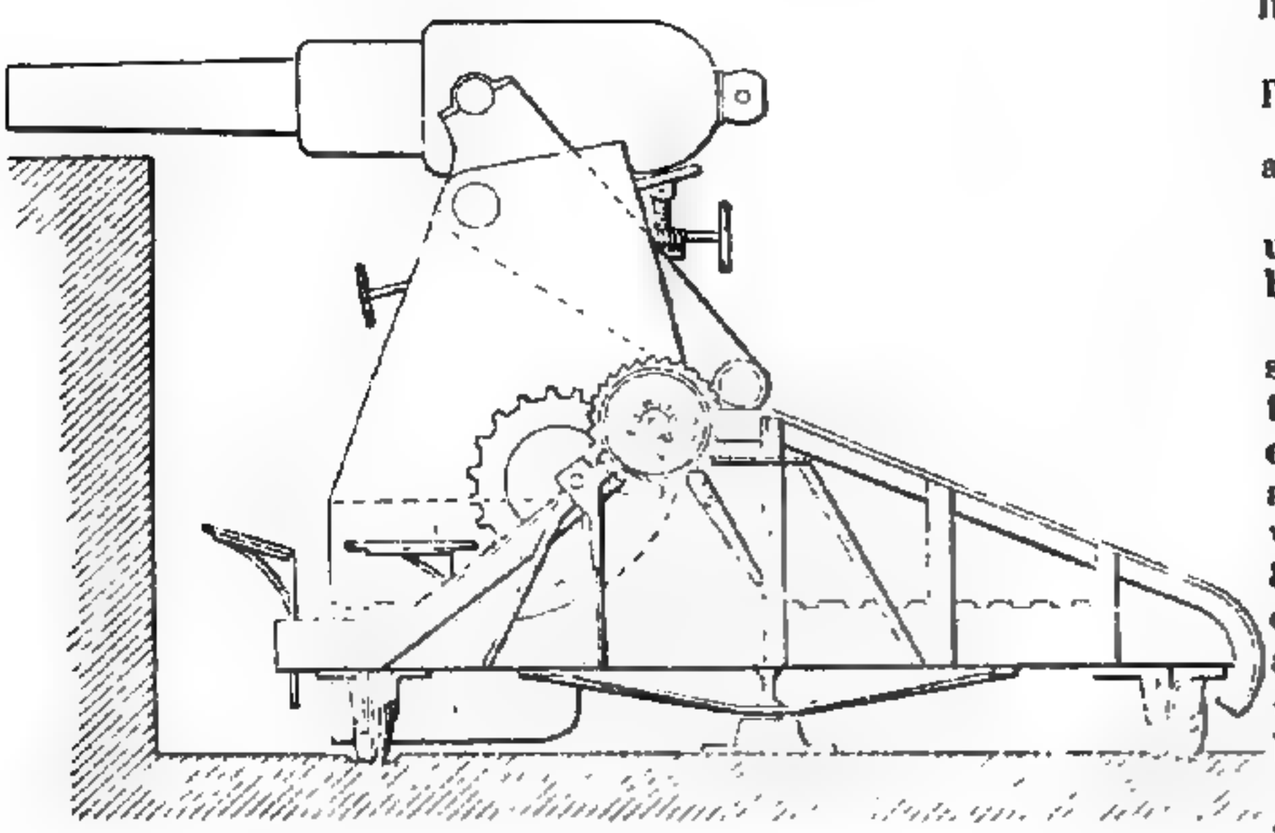
For counterpoise carriages see:—

Brewer's gun-carriage, 1870, is supported on a platform which is supported by levers within a curb, and a weight suspended from the ends of the levers counterpoises the gun, carriage, chassis, and platform.

Callender and Northrup, 1864, have a platform supported by a piston in an air-cylinder beneath.

Eads (1865, 1869, and 1871) causes the recoil of the gun to depress it backwardly and downwardly, it being poised on its trunnions on the end of an arm which oscillates in an arc. As the gun descends,

Fig. 2341



Moncrieff's Gun-Carriage.

a piston traverses in a cylinder, compressing air therein, and the elasticity of the air assists in restoring the gun to its position when the loading is complete.

Coughlan, 1870, has a cogged segment and weighted toggle which allow the gun to depress by the force of recoil.

Taggart, 1863, has two guns on a cylindrical carriage which is on an axis reaching athwart the vessel. The gun beneath is in loading position below decks, while the one above is in firing position. The latter being fired, the axis is rotated and the guns change places.

Winans, 1865, lifts his gun, carriage, and traverse into firing position by steam piston and cylinder beneath.

Houel and Caillet have a system of levers which oscillate backwardly by the recoil, and in so doing bring into action a spring which afterward assists in restoring the gun to firing position. See also Coon, 1863; Foster, 1869.

Wappich, 1863, has a toggle-joint and screw for elevation and depression. Also screws beneath the trunnions.

In Moncrieff's gun-carriage (Fig. 2341) the gun is supported upon a moving fulcrum, which, on the firing of the gun, is caused to shift nearer to the gun and farther from a counterweight, spring, or other force, while at the same time the gun is brought into a lowered position for reloading, and is then automatically raised into position for firing. By the shifting of the fulcrum, the statical momentum of the balance weight is made to preponderate so greatly over that of the gun that it will, when allowed free action, after the loading of the gun, raise the same into its original position.

For running the gun in and out of battery, and traversing and operating guns in turrets, see patent of Ericsson, 1866, 1870; Perley, 1865, 1867; Eads, 1864, 1865; Bartol, 1863. Training twin guns in parallelism in turrets, Eads, 1866.

Eads, 1864, 1865, has a means for training the gun upon an imaginary center, which is the center of the exterior opening of the port or embrasure, so as to reduce the opening to the smallest size.

Gun-cot'ton. The first notice of the discovery of gun-cotton was made by Braconnet, in 1833, who detailed the action of nitric acid on starch, sawdust, linen, and cotton. He called it *xyloidine*.

Pelouse, in 1838, called attention to this compound.

Dumas, in 1843, again cited a mode of preparing, and made suggestions for the application.

Schönbein, in 1846, brought forward his plan of using nitric and sulphuric acids. It was described by W. H. Ellet of Columbia, S. C., in 1846.

Baron Von Lenk, 1864, used cotton skeins instead of employing the wool in masses, thus rendering the saturation more complete and the manipulation easier. The loose cotton thread is first boiled in an alkaline solution and afterwards placed in a cylinder with perforated wire sides, making from 600 to 800 revolutions per minute, by which the alkali is expressed; it is then washed in clean water and again subjected to the action of the cylinder, after which it is thoroughly dried by exposure to air and by heating in a chamber to about 120°.

One-pound charges of the cotton thus prepared are next immersed in a mixture composed of 3 parts of sulphuric to 1 of nitric acid, which has been allowed to cool from 48 to 72 hours; the vessels containing the cotton and acid being surrounded with cold water to prevent undue heating during the chemical action which ensues.

The cotton is then placed on a strainer and expressed until it retains but about ten times its weight of acids, when it is removed to an earthenware jar, surrounded by water as before, where it is allowed to remain forty-eight hours to insure its complete conversion into "trinitro cellulose," or gun-cotton. It is then taken out and washed by plunging suddenly in water, to prevent heating; and afterwards placed in a tank of running water for forty-eight hours, and dried in the centrifugal machine; this bathing and draining process is repeated six times, when the cotton is finally washed in a warm alkaline solution to remove all the uncombined acid. Up to this period the cotton has been in a greater or less degree damp, since it was first subjected to the action of the acids, but after assuming its final shape is dried in charges of twenty pounds in fire-proof cages. See also Levy's process, 1865; and appendix to A. L. Holley's "Treatise on Ordnance and Armor."

Mr. Abel, of the Woolwich (England) Dock-Yard Chemical Department, has discovered that the explosive force of gun-cotton, like that of nitro-glycerine, may be developed by the exposure of the substance to the sudden concussion produced by a detonation, and that if exploded by that agency the suddenness and consequent violence of its action greatly exceeds that of its explosion by means of a highly heated body of flame.

Charges for sporting or blasting purposes are sometimes put up with a core of raw cotton, to diminish the force of explosion.

Wet gun-cotton is of course proof against explosion by heat, but it has been found that its explosive energy is rather increased than diminished when wet and fired by percussion. A body of gun-cotton thrown into the sea in a net, with a protected priming of dry cotton and fulminate, will explode with as much force as if confined in a water-tight vessel.

The rapidity with which gun-cotton detonates has been computed at 20,000 feet per second. Its energy is from two to four times that of gunpowder. See EXPLOSIVES.

Gun-cotton is not soluble in alcohol or ether, but in a mixture of the two it dissolves readily, giving rise to a perfectly colorless mucilaginous liquid, known as *collodion*. This dries quickly to a hard skin, quite structureless, and possessing considerable strength. It is used in surgery, and also, in conjunction with iodides and bromides, to form the collodion of the photographer.

"The cotton is first thoroughly cleansed by boiling it in an alkaline solution and exposing it to a current of air, and then again boiling it in clean water. After the second boiling it must be again thoroughly dried, first by a centrifugal machine, and afterward by being passed over a current of hot air, the wet meeting the cold current, and as it dries rising to a temperature of about 120° F. The cotton, in charges of one pound each, is then steeped for five minutes in a bath containing three parts of sulphuric acid and one part of nitric acid, after which it is taken out and placed in an iron cylinder, and a perforated piston, about 8″ in diameter, is forced down upon it by hydraulic pressure. The excess of acid pressed out of the cotton passes through the perforations in the disk and is pumped off. The cotton is then placed in glazed earthenware jars, which are covered in order to prevent any heating taking place, the jars being placed in a current of cold water, where they are allowed to remain for 24 hours, after which the cotton is taken out and again thoroughly washed, and while yet damp is passed between rollers until it is reduced to a very fine powder; this process being gone through while the compound is damp, prevents any possibility of its explosion. The powder is then mixed with a certain quantity of sugar, nitric acid, and water, into a pulpy mass, which, after being strained through a fine sieve, is carefully dried in a temperature never exceeding 120° F. The manufacturing process is finally completed by passing it through rollers under very high pressure, by which means it is compressed into a hard substance and rendered almost impervious to damp. The gun-cotton intended for blasting purposes is made into thin cakes, broken and irregular in size, but for rifle cartridges it is made in small pellets, similar in form and size to rape seed."—"*Universal Engineer.*"

Gun-lock. The combination of parts by which the propulsive charge is caused to ignite. The matchlock, the first known employment of which was at the battle of Morat, 1476, was the earliest known form. In this a piece of slow-burning cord was passed through a hole in the cock, which was thrown forward on pulling the trigger, bringing the lighted end of the cord in contact with the priming. The gun with this attachment was called an arquebus. It continued in use until the invention of the wheel-lock in Italy, about 1521. In this, a furrowed steel wheel was, by means of a spring and chain, caused to revolve in contact with a piece of native sulphuret of iron, producing sparks which ignited the priming. This mineral is said to have originally derived its name pyrites, or firestone, from having been thus employed.

The "snaphaunce" lock comprised a hammer carrying a flint, which was caused to strike against a furrowed piece of steel, which performed the office of the battery in the more modern flint-lock. It is said to have been contrived by German or Dutch marauders, to avoid the exposure attending the use of the matchlock in nocturnal expeditions.

The flint-lock is said to have originated in France about 1635, and its general features do not appear to have essentially changed in the two centuries, nearly, during which it was used to the exclusion of all others. The parts corresponded to those of the percussion-lock of the present day, except that the hammer was provided with a pair of jaws for holding the flint, which was caused to strike a pivoted lip called the *battery*, throwing it back and dropping a shower of sparks into the "pan" containing the priming.

In 1807 Rev. Mr. Forsyth obtained a patent in England for a fulminating powder, which was to be placed in a magazine at the breech of the gun and fired by a pin. Various modifications were devised prior to the introduction of the common copper cap, about 1816. This, however, made its way rather slowly. It was not until 1842 that the percussion lock and cap were adopted in the United States military service.

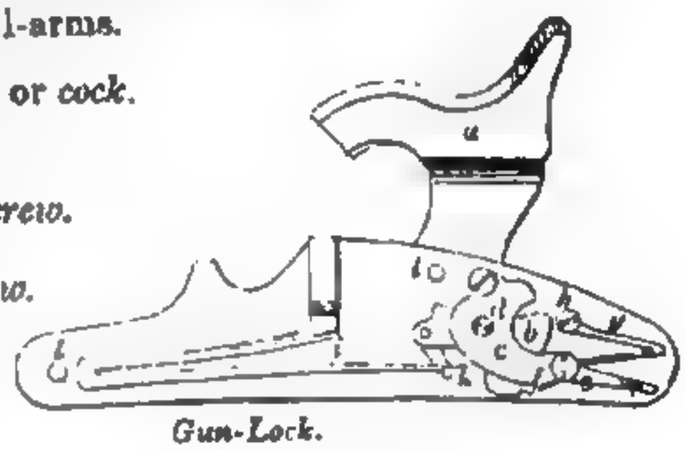
The adaptation of the flint-lock to cannon was easy, it being merely necessary to secure the lock in position by a ring around the breech of the gun; when the hammer fell back, on firing, the blast from the vent passed freely, without injury to the lock. It was otherwise with percussion-locks when applied to a vent two tenths of an inch in diameter. The shock of the blast would soon have destroyed such a lock without the hammer was withdrawn from over the vent at the very instant of firing. This difficulty was obviated by E. Hidden's lock, first patented in 1831 and subsequently improved.

In this, that end of the hammer to which the lanyard is attached is longitudinally slotted, so that the same pull which brings the hammer down upon the head of the primer withdraws it back a slight distance, leaving the blast unimpeded. Friction primers for cannon have generally superseded the use of this lock, though it still maintains its place in the United States navy.

The elements of all gun-locks of the modern pattern, which have no breech-loading or revolving machinery to operate, are essentially as follows. The illustration shows that employed in the United States muzzle-loading small-arms.

Fig. 2343.

a, *hammer* or *cock*.
b, *tumbler*.
c, *bridle*.
d, *bridle-screw*.
e, *scar*.
f, *scar-screw*.



Gun-Lock.

g, *scar-spring*.
h, *scar-spring screw*.
i, *mainspring*.
k, *swivel*.
l l, *side screws*.

The hammer fits on the *square* of the *tumbler*, which it rotates when drawn back, so as to allow the *nose* of the scar to fall into notches of the tumbler when at half-cock and at cock. Both the scar and tumbler are held in place by the *bridle*, which confines them to the lock-plate. The trigger, when pressed, acts on the rear end of the scar, lifting the other end out of the cock-notch of the tumbler, which is then permitted to move by the action of the mainspring, carrying the hammer around with it.

Revolving, breech-loading, and repeating arms, having their firing mechanism necessarily operating in connection with those for loading and for withdrawing the cartridge-cases, require very different arrangements from those described, in many instances involving great multiplicity and complexity of parts. These will be found noticed under the head of FIRE-ARMS, where a list of about 1000 occurs.

The lock of the needle-gun is the widest departure

from the well-remembered form, the striker being a pointed rod which explodes the fulminate, either in the base of the ball, as in the Prussian gun, or in the base of the capsule, as in the American form of rifles. The percussion powder may be in a cap placed on a nipple on the side of the barrel; in a cap over a nipple on the cartridge; a pellet on an anvil at the base of the cartridge; a pellet or ring in a basin or in the flange of the cartridge; a pellet in the base of the bullet.

Gun-lock Ham'mer. The cock or striker of a fire-arm lock. See GUN-LOCK.

Gun-met'al. A bronze from which cannon may be cast. Ordinarily 9 parts copper and 1 tin. Other metals have been sometimes added or substituted for the tin, copper still remaining the basis of the alloy.

A few examples are given.

	Copper.	Tin.	Zinc.	Iron.
Common formula . .	9	1		
Stirling's (English) .	50		25	1–8
Rosthorn's (Austrian) .	55.04	0.83	42.36	1.77
Rosthorn's (Austrian)	57.63	0.15	40.22	1.86
Navy (Austrian) . .	60		38.12	1.8
Birkholtz (U. States)	60		38	2.0
Kelly's (English, 1799)	100		75	10
Lancaster's (English)	90	10		

See ALLOY.

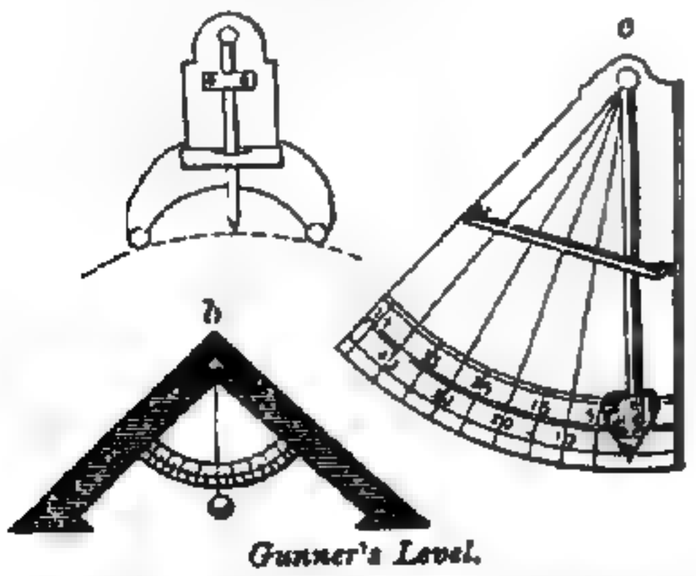
The Rosthorn (Austrian) alloys are known as "sterro-metal." One variety is soft, ductile, and capable of being worked into sheets or wire. The other is hard, and is represented as suitable for ordnance. From experiments made at the Imperial arsenal at Vienna, its tensile strength was, after single fusion, 28 tons to the square inch; after forging at a red heat, 32 tons; drawn cold and reduced from 100 to 77 sectional area, 37 tons. The metal thus tested contained a rather less proportion of tin and iron than is indicated above. Its specific gravity was 8.37. It is represented as possessing unusual elasticity. Field-guns of from 4 to 12 pounder caliber were worked out of single pieces under the hydraulic press, without impairing its tensile strength.

Gun'ner's Cal'i-pers. An instrument made of sheet-brass with steel points. The graduations show the diameters of shot and shell, the calibers of guns, linear inches, degrees of the circle, etc.

Gun'ner's Lev'el. An instrument for ascertaining the highest points at the breech and muzzle of a piece of ordnance, when on uneven ground, in order to determine the true line of sight.

It consists (*a*, Fig. 2344) of a spirit-level mounted on a frame having two branches with rounded ends,

Fig. 2344



Gunner's Level.

and an upright piece with a perpendicular slider. The instrument is placed transversely on the upper part of the gun, say at the base ring, and moved to the right or left until the bubble of the level is central, the point of the slider then indicates the highest point of the piece at that part; repeating the operation at the muzzle gives another point in the line of sight, along which the gunner must aim to hit the object. These points are then marked on the metal.

Called also gunner's perpendicular.

b and *c* represent forms of what are called gunner's levels in the British service. Each of these is designed to be applied longitudinally to the gun to give it the proper elevation, the degree of which is ascertained by the graduated quadrant and plumb-bob.

Gun'ner's Per'pen-dic'u-lar. Another name of the gunner's level. It is made of sheet-brass, the lower part being cut out in crescent shape. It has a perpendicular slider, pointed at the lower end, and is used for finding the line of sight of siege-guns and mortars. See GUNNER'S LEVEL.

Gun'ner's Quad'rant. The gunner's quadrant is a graduated arc of 90°, or rather more, made of brass or wood, and having an arm attached which is passed into the bore of the gun for the purpose of ascertaining the elevation. The wooden level has a leaden bullet suspended by a string, which indicates the perpendicular, the deviation from which is measured on the arc. The metallic quadrant is of more elaborate construction, and has a spirit-level attached. See GUNNER'S LEVEL.

Gun-pend'u-lum. 1. A pendulous box with sand-bags to receive the impact of a ball fired from a gun or cannon, and used to determine the strength of powder. See BALLISTIC PENDULUM.

2. A gun suspended from trunnions to measure by recoil the power of the powder of the exploded charge. See also ÉPROUVETTE.

A substitute means is a measurer of the rate of motion of the projectile, which forms one factor in the calculation for the power of the powder. See CHRONOSCOPE.

Gun'pow-der. A composition of niter, charcoal, and sulphur. The proportions in which these ingredients are mixed vary slightly, according to the place of manufacture or the destined use of the article. By the atomic theory there should be in 100 parts, 74.64 niter, 13.51 charcoal, 11.85 sulphur. In practice there are employed, —

	Niter.	Charcoal.	Sulphur.
In the United States, military purposes . .	76	14	10
Or	75	15	10
In the United States, sporting	78	12	10
	77	13	10
In England, military purposes	75	15	10
In England, sporting .	78	14	8
	75	17	8
In France, military purposes	75	12.5	12.5
In France, sporting . .	78	12	10
In France, blasting .	62	18	20
In Prussia, military purposes	75	13.5	11.5

Although the use of gunpowder in Europe can be traced back only to the middle or earlier part of the fourteenth century, yet it seems fully proved from various passages in ancient authors that it is one of those inventions whose origin is lost in the obscurity of a very remote antiquity. The fact appears indis-

putable that it originated in Central or Eastern Asia, where it was used for many ages previous to its introduction into Europe, where it appears to have been first made known by the Saracens.

The arts of making silk and other fine goods, crystal glasses, and jewelry, were carried to the Netherlands and to England by the Revocation of the Edict of Nantes, granted by Henry IV. in 1598, confirmed by Louis XI. in 1610, and Louis XIV. in 1652, and revoked by Louis XIV., Oct. 22, 1685. Fifty thousand Protestant families left France for more tolerant countries, and the world is the better off from the diffusion of their skill.

The more closely we examine the record, the more do we discover our indebtedness to the East; and the extreme East seems to have been the primary fountain of our industrial civilization.

The use of an explosive compound, *pulvis nitratus*, is mentioned in an Arabic writing in the Escurial collection, dating about 1249. The Moors used it in Spain in 1312, and in 1331 the king of Granada battered Alicant with iron bullets, discharged by fire from machines. In 1342–43, the Moorish garrison of Algesiras defended themselves against Alonzo XI., king of Castile, by projectiles fired from cannon by powder.

The Venetians used gunpowder in their wars with the Genoese in 1380. Gunpowder is mentioned in the French national accounts, 1338, and is said to have been used at Cressy, 1346, and to have contributed much to the success of the English.

The two Europeans whose names have been prominently brought forward as inventors of gunpowder are Roger Bacon and Michael Schwartz.

Roger Bacon, in 1216, wrote a work entitled "The Secrets of Art and Nature," wherein he states that "from saltpeter and other ingredients we are able to make a fire that shall burn at what distance we please; and that sounds and coruscations resembling thunder and lightning might be formed in the air, much more to be dreaded than those that happen naturally, inasmuch as by its power armies and cities might be destroyed." Bacon did not claim the discovery, and had probably read the "Liber Ignium" of Marcus Græcus, written about A. D. 825, in which he describes the nature of the composition for making rockets. His formula is stated by one authority to have been, — sulphur, 1; charcoal, 2; saltpeter, 6. It is now difficult to sift the error from the truth, but it is said that in the recipe of Bacon the ingredients saltpeter and sulphur were given, and that the charcoal was stated anagrammatically, by the transposition of the letters of the words, *carbonum pulvere;* which he wrote "Lura nope cum ubre." This looks as though he considered it a secret; not necessarily his invention, but a dangerous compound not adapted for the use of the vulgar.

Michael Schwartz, a Cordelier monk, of Goslar, in Germany, about A. D. 1320, seems to have combined the three ingredients, and has been credited with the discovery. A commemorative statue of Schwartz was erected in 1853, at Freiburg.

Artillery was known in France in 1345.

In 1356, the city of Nuremberg purchased gunpowder and cannon.

The same year Louvain employed thirty cannon at the battle of Santfliet against the Flemings.

In 1361, a fire broke out at Lubec from the careless use of gunpowder.

In 1363, the Hanse towns used gunpowder in a conflict with the Danes.

It is commonly stated that gunpowder was first made in England, at periods varying from 1411 to 1438; but recent research by Rev. Joseph Hunter has brought to light records of its manufacture for the uses of the English army before it landed at La Hague, and previous to the battle of Cressy.

In a code of Gentoo laws occurs a prohibition against the use by the ruler of "deceitful machines, poisoned weapons, and weapons of fire." To this document is assigned the date 1500 B. C. When Ghengis Khan invaded China, A. D. 1219, he carried with him *ho-pao*, or fire-tubes, which killed men and set fire to buildings.

Passages in Quintius Curtius and Philostratus indicate that Alexander was met in India by a people who used against him "storms of lightning and thunderbolts."

There are many scattered passages in the old writers, and many facts, quoted by Dutens, Sir George Staunton, Halhed, Hallam, M. Langles, Muratori, Reinaud, and Grove, which indicate the very early use of gunpowder.

It must be recollected that in many parts of Asia saltpeter occurs as an efflorescence on the surface of the ground, and its sputtering effects upon ignited charcoal, when a fire was built upon it, must have been very commonly observed. Sulphur is useful in the combination, but not essential for some purposes to which the explosive compound is applied.

In early ages, probably as early as the time of the exodus of the Israelites from Egypt, fire-works were common in China, and from thence, at a very remote period, they spread to India, where they were used on a scale which made them dangerous weapons when Alexander invaded that country, 327 B. C. There is no reasonable doubt that, long before they were employed as weapons, rockets and other pyrotechnic devices were used among these Eastern Asiatic nations, especially among the Chinese, with whom they have for many centuries formed an important item in public celebrations and festivals. From those devices, in which a charged paper tube expels fire-balls or pellets of explosive material, the transition is very easy to larger tubes with projectiles, which depend for execution upon percussive force. Such were the original fire-arms, and the strengthened paper tube or the bamboo was the first barrel.

We have occasion to notice, in the course of this work, that many arts in which the Chinese excelled were carried to India, and were cultivated in that congenial soil, until an irruption of another nation scattered the artificers or scholars, and gave to the world the secret or the industry which was locked up, as it were, within circumscribed limits. This has commonly occurred in the history of the industrial arts.

War quickened the extension of printing. In 1482 the storming of Mentz dispersed the workmen, and gave the art of printing to the world.

In 1146 Roger of Sicily plundered Greece, and took home with him to Palermo silk-worms, workmen, and the art of weaving silk. From Sicily it spread to France, Italy, and Spain, and from Italy to England.

Other instances might be cited where the irruptions of tribes or nations, or internecine disturbances, have disseminated arts, but the one most to our purpose is the invasion of India by Mahmoud of Ghizni, A. D. 1004, which seems to have been the means of diffusing the knowledge of gunpowder, the mariner's compass, and the art of glazing pottery

and earthenware. The Saracens were the means of publishing the knowledge thus dispersed, and we regard it as certain that they introduced the knowledge of gunpowder into Europe.

The ingredients for the manufacture of gunpowder should be of the greatest possible purity. The crude saltpeter is refined by washing, and then dissolving in the least possible proportion of hot water, and clarified by adding a very small quantity of glue, and boiling until the impurities, such as chloride of sodium, are deposited and the liquid becomes perfectly clear. It is then drawn off into pans, where it is cooled and crystallized in very minute grains, and afterwards washed with cold water, dried, and sieved. It should not contain more than $\frac{1}{300}$ part of chlorides. That used in the best powder does not contain more than $\frac{1}{1000}$, and for the best sporting powder it undergoes a second refining, and contains not more than $\frac{1}{8000}$ part.

The charcoal has a great effect upon the quality of the powder. It should be light, friable, and porous, burning freely, and leaving little ashes. The woods used are willow and black-alder, principally the former. Branches not exceeding $\frac{3}{4}$ inch diameter are selected, barked, and dried, after which they are charred in upright cast-iron cylinders, heated from the outside; about 65 per cent of the weight is found to pass off in the gaseous products distilled from the wood, leaving only 35 per cent of coal. It should only be prepared as required for use, owing to its liability to absorb moisture, and to spontaneous combustion when stored in quantities exceeding 30 pounds weight.

Sulphur is refined by sublimation, the chamber in which the vapors condense being kept at a temperature of about 248° F., so as to allow the sulphur to be drawn off in liquid form. If much lower than this it condenses in the form of a powder, called flowers of sulphur, which always contains a proportion of sulphurous and sulphuric acids.

The three ingredients are now incorporated.

Dr. Scoffern's description of the process as conducted at the National Mills at Waltham, England, which produce powder of unsurpassed quality, gives a good general idea of the mode of manufacture.

It may be remarked that the process commonly employed in this country, though almost identical, differs somewhat in the preliminaries. Here the saltpeter is usually found sufficiently pulverized as it comes from the refinery. The charcoal is pulverized by being placed in a large cast-iron barrel, having ledges on its interior, with twice its weight of bronze balls, and the barrel is caused to rotate at the rate of from 20 to 25 revolutions per minute for two or three hours. The sulphur is similarly treated in barrels made of thick leather stretched over a wooden frame, and revolved from four to eight hours. The ingredients are incorporated by placing the charcoal and sulphur together in a rolling barrel, similar to that in which the sulphur is pulverized, and rolling them for one hour. The saltpeter is then added and rolled for three hours longer, after which the mixture is transferred to the cylinder or rolling mill, which consists of two cast-iron cylinders rolling in a circular trough with a cast-iron bottom.

At Waltham, the saltpeter, brimstone, and charcoal are ground separately in mills, each consisting of a pair of heavy circular stones slowly revolving on a stone bed. Next the ingredients are conveyed to the *mixing-house*. Here, in bins, are the saltpeter, brimstone, and charcoal, weighed in the exact proportions: saltpeter, 75; brimstone, 10; and charcoal, 15; in every 100 parts. Of the three ingredients, forty-two pounds are placed in a hollow drum, which revolves rapidly, and contains a fly-pan, which rotates in an opposite direction; in about five minutes a complete mixture is effected, and the charge is received in a bag tied over the lower orifice of the drum.

The *composition* is next taken to the *incorporating-mills*, and is now a *combustible* compound, which will acquire an *explosive* power by the thorough incorporation of ingredients. The mill consists of a pair of circular stones (*runners*) weighing about 3½ tons each, and slowly rolling over the powder, which is placed on the stone bed of the mill, surrounded by a huge wooden basin. The powder is previously damped, as it could not be safely ground dry; about seven pints of water (*liquor*) being added to the charge of forty-two pounds of powder during three and a half hours, the time of grinding. To insure this with precision, and to obviate the chance of any irregularity in a clock, the water-wheel which works two of these mills in one house also marks its revolutions on a dial, so that the attendant can never be mistaken in the time the charge has been "on,"—a most important point, where the over-grinding of the too dry powder might cause it to explode. Sometimes a portion of the wood-work of the roof, or mill, becoming detached—such as a cog of the wheel—and falling into the pan, acts to cause a mass of powder to explode. As a protection, over each house containing a pair of mills is suspended a flat board, which, in case of an explosion, is first blown upward, and, being connected by wires to a cistern of water over the pan of the fellow mill, upsets the same, and drowns the gunpowder. The attendants are as little as possible in these mills, and only work by daylight. More hazardous processes, however, follow. The powder thus incorporated is in hard, flat lumps, and has again to be reduced to dust in the *breaking-down house*, by conveying it down an inclined plane, through rollers, which crush nearly 500 pounds in the hour. The powder is then taken to the *press-house*, and there, between gun-metal plates, is pressed in thin cakes to one third its bulk by a power of 700 tons in an hydraulic press. The cakes are roughly broken up, and sent in baskets to the *granulating-mill*, where the powder is again broken down into grains, the size being regulated by sieves. The floor is covered with hides fastened down with copper nails, and the mill can be started or stopped by a rope passing through the wall, which is bomb-proof. The powder is then dried, by heat, in the *stoving-room*, which is flanked externally by *traverses* (mounds of earth thirty feet thick), to confine explosion, should it happen, as much as possible to one house. Lastly, the powder is sifted in the *dusting-house*, where the sieves revolve with great velocity; the dust escapes through the meshes, and the gunpowder is drawn off through a sort of tap, into barrels, for packing. The finest powder is *glazed* by black-lead being shaken up with it; but cannon powder has not this finish.

The size of grain of gunpowder is varied according to its intended use. The finest is known as *sporting*, the next *rifle*, then *musket*, and lastly *cannon* powder. The rapidity of burning is in inverse proportion to the size of the grain. For very heavy

ordnance a much larger grained powder than either of the above, called *mammoth* powder, was introduced by the late General T. J. Rodman. He also proposed the use of a powder composed of small uniform cakes with cylindrical perforations. This has since, under the name of *prismatic* powder by the Germans and Russians, and *pebble* powder by the English, been received with considerable favor.

The use of sawdust, resin, bran, sand, ashes, wood shavings, is as old as the writings of Siemienowicz, 1651. He remarked, very truly, that they have the effect of making the powder burn more slowly. The practice has been again and again introduced, in Brazil about 1800; by Thurnagel in Germany; Thomassin and Leblanc in France; Firzoo in Russia.

Dr. Gale has shown that by the addition of sand in certain proportions the powder is rendered non-explosive.

The white gunpowder invented by Captain Schultze, of the Prussian army, is prepared by sawing suitable kinds of wood into thin slices transversely of the grain. These are then, by means of a manifold punch, cut into grains of a definite size and shape, which are chemically washed to remove calcareous and other non-woody matters, and then treated with a mixture of nitric and sulphuric acids, washed with a solution of carbonate of soda and dried. In this condition the powder is stored away until it is wanted for shipment. It may be considered as a dense form of pyroxyline. The explosive quality is imparted by steeping in a solution of some one of the nitrates, ordinarily that of potash (saltpeter), but for some purposes the inventor prefers nitrate of baryta.

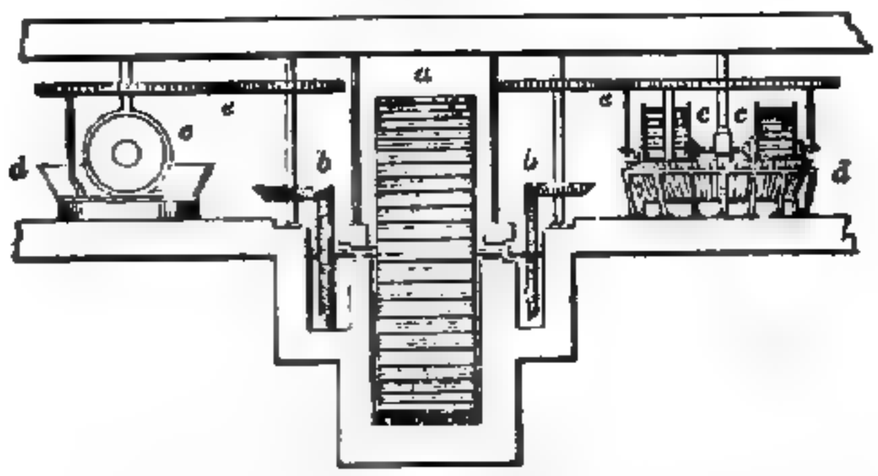
Another recipe for white gunpowder consists of equal parts of chlorate of potash, white sugar, and ferro-cyanide of potassium. Mix very cautiously, as it explodes by percussion. It is exploded by a red-hot body or a drop of sulphuric acid.

The following table shows the first recorded use in making gunpowder of the ingredients stated.

Charcoal, sulphur, and nitrate of potassa	*Time immemorial.*	Aloes	1869
Bituminous coal	1838	Fats and oils	1871
Bark (morus)	1855	Lime	1861
Peat	1856	Phosphorus	1864
Cork (burned)	1856	Bisulphide carbon	1868
Lycopodium	1856	Ferro-cyan. of potassa	1850
Horse-dung	1856	Chlorate of potassa	1850
Sawdust	1856	Carbonate of potassa	1859
Sugar	1856	Bichromate of potassa	1864
Tan	1856	Carbazotate of potassa	1868
Starch	1858	Azotate of potassa	1868
Flour	1858	Chloride of sodium	1858
Bran	1858	Nitrate of sodium	1857
Gum	1859	Sulphate of sodium	1862
Cannel coal	1831	Potasso-tartrate of sodium	1864
Caoutchouc	1863	Barilla	1864
Dextrine	1864	Carbonate of sodium	1864
Petroleum products	1864	Chlorate of lead	1862
Lamp-black	1835	Red sulphate of arsenic	1850
Cutch and gambier	1866	Sulphate of magnesia	1862
Grahamite	1869	Nitrate of strontian	1862
Paraffine	1869	Nitrate of baryta	1862
Logwood	1869	Nitrate of lead	1864
Carbolic acid	1869	Nitrate of iron	1869
Tannin	1869	Binoxide of manganese	1864
		Cyanuret of zinc	1864

Gun'pow-der-mill. Fig. 2346 shows an arrangement by which several gunpowder rolling-mills are driven from a water-wheel *a* by bevel and spur-gears *b b c c*. The cast-iron or stone rolling-cylinders *c c* revolve on a horizontal axis which is carried around by a vertical shaft within the circular trough *d*, into which a charge, usually 75 or 150

Fig 2346.

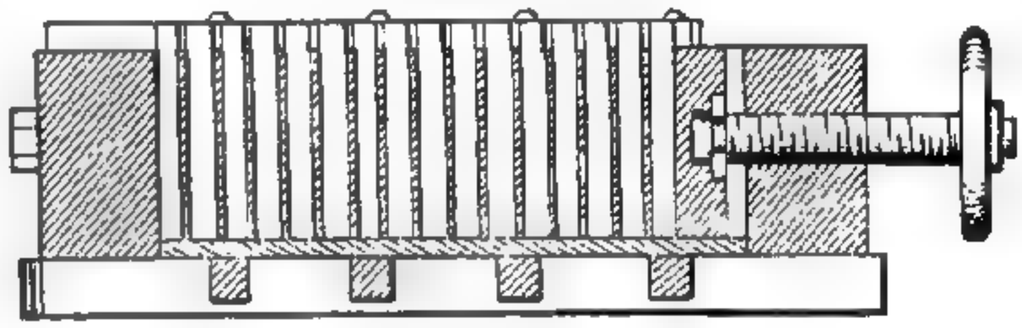


Gunpowder-Mill.

pounds, of the incorporated materials from the rolling barrel has been placed. The rollers are set in motion, slowly at first, and afterwards more rapidly, and kept going three hours for a charge of 150 pounds, or for a less quantity a proportionately less time, a little water being added to prevent danger of explosion should the materials become too dry. A scraper follows each roller to keep the composition exposed to the action of the rollers. At the end of this time the mass has become thoroughly incorporated, is of a brownish red color, and is termed *mill-cake*. See GUNPOWDER.

Gun'pow-der-press. For pressing *mill-cake* into hard cake preparatory to granulating. That illustrated is particularly designed for compressing

Fig. 2347.



Gunpowder-Press.

dust-powder into hard cakes between upright plates which are adjustably arranged in the box by means of a gage-bar. The pressure is applied by a follower operated by a horizontal screw.

Gun'pow-der Pa'per. A substitute for gunpowder. *Powder-paper* consists of paper impregnated with a mixture of potassic chlorate, nitrate, prussiate, and chromate, powdered wood-charcoal, and a little starch. The powder-paper is rolled into the shape of a cartridge of any required length or diameter. It is said that no explosion can take place except by way of contact with fire. Also that the powder paper leaves no greasy residue on the inside of the gun, produces less smoke, gives a less violent recoil, and is less impaired by humidity than gunpowder. With equal charges, by weight, of gunpowder and powder-paper, the penetrating power of the latter is 5-16ths greater than that of the former.—"*Pop. Science Monthly*," x., p. 253.

Gun-search'er. An instrument with several projecting prongs to ascertain whether the bore of a gun be honeycombed.

Gun-stock. The part of a gun to which the barrel and lock are fastened. It is usually of walnut; in Europe the *Juglans regia*, in America the *Juglans nigra*.

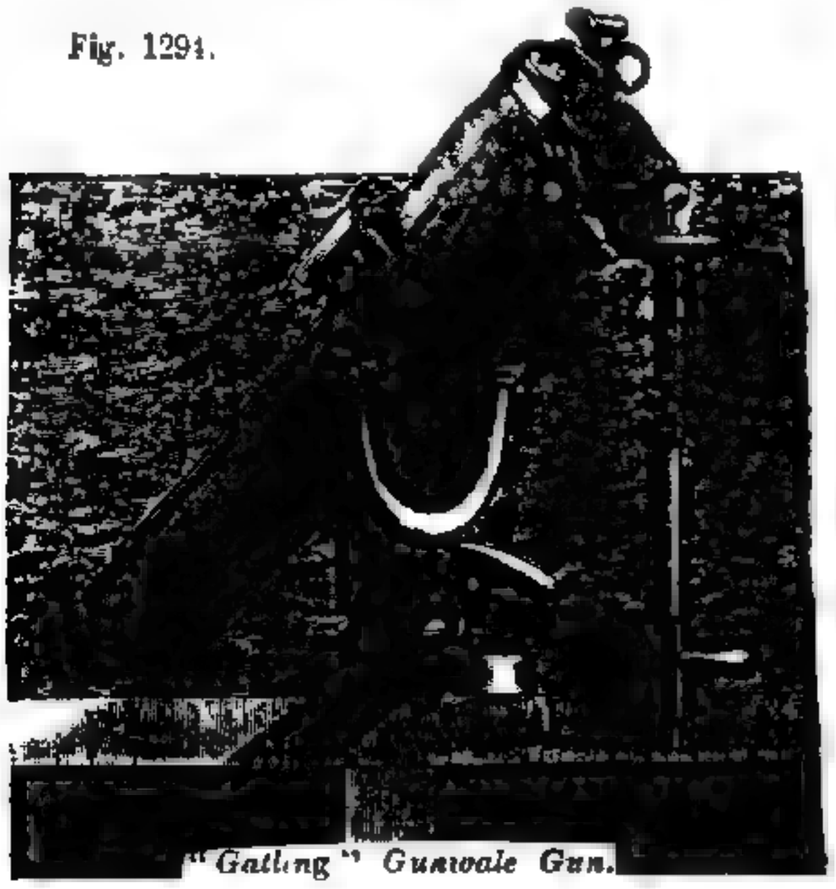
Gun-stocks, until the invention of the Blanchard lathe, were made by hand in a laborious and tedious

manner. This machine was introduced into the Springfield Armory about 1820.

A rough chunk of wood is placed in the first of the stocking machines, from whence it emerges with its sides cut to the proper shape for turning. In another machine its butt-end is sawed, and a diagonal line cut at the breech. The third, armed with two circular saws, fashions the upper part of the stock in its finished form. Another machine reduces the butt to its ultimate shape. Another simply planes various places in the sides of the stock as points for the working of yet other machines, — an operation which is known as *spotting*. A sixth machine performs six distinct items, called *grooving* for the barrel, breech-pin, and tang; *heading* down, *milling*, and *finish-grooving*. The stock is at this stage prepared for the *fitting* in of the barrel. A seventh machine planes the top, bottom, and sides, while the eighth and ninth do the *shaping* and *bedding* for the butt-plates. The next machine prepares the stock for the reception of the lock. Another machine is used to cut for the guards, to bore for the side screws of the lock, and two more to make places for tips and bands. After these various operations comes the second turning and smoothing of the work; then the grooving for the ramrod; then the boring for the ramrod from the point at which the groove ends. These machines are each provided with a pattern or templet, which is the exact counterpart of the cavity or other form to be produced in the stock. They are furnished also with cutters or borers, which, being placed above the stock, are made to revolve rapidly and cut the wood in exact imitation of the pattern below. The movements of the tool are controlled by a guide which is inserted within the pattern. The tool is made to revolve by means of small machinery within its frame, the latter and all within it moving together with both lateral and vertical motions, being governed by the guide, which is connected with it, by the aid of very curious and intricate machinery.

The work of the artisan, when the machine is in motion and the stock is adjusted in its bed within it, beneath the borers or cutters, is simply to bring the guide down into the pattern, and move it about the circumference and through its center. The cutting-tool follows the movements of the guide, and the result is a perfect duplicate in the stock of the form in the mold below. See LATHE FOR TURNING IRREGULAR FORMS.

Fig. 1294.



"Gatling" Gunvale Gun.

H

Hag'but. An old fire-arm with a stock bent down to form a ready means of grasping. An *arquebus*.

Hair-trig'ger. (*Fire-arms.*) The secondary trigger of a gun. Its movement is effected by a very slight force, and unlocks a secondary spring device called a *hair*, which strikes the tumbler-catch and throws the sear out of the notch in the tumbler.

Hal'berd. 1. A weapon formed of a blade on the end of a pole.

This was a common weapon among the Romans (*falx*, *falcula*), either short-handled like the English bill-hook, or on a long handle like the Tudor halberd. It differed from the *cultus* in having a curved cutting edge.

Half-bent. The half-cock of a fire-lock.

Half-cock. (*Fire-arms.*) The position of the gun-lock when the nose of the *sear* is in the first or deep *notch* of the *tumbler*. From this it cannot be pulled off by the trigger.

Ham'mer-cap. A cover for the cock of a gun.

Ham'mer-less Gun. One without exterior hammer; usually fired by concealed spring-pin. The term may include the needle and bolt guns.

That shown in Fig. 1298 is by Greener, of Birmingham, England. It is shown by longitudinal section. The barrels are hinged to the breech-frame in the usual manner, but in-

Fig. 1298.

Hammerless Gun.

stead of the ordinary gun lock with outside hammers, the tumblers *A* are made nearly in the form of an elbow lever. These tumblers have their upper ends curved forward, and are provided with a small rounded point, which is arranged to strike through a small hole at the center of the breech piece instead of the ordinary firing pin. The lower front portions of the tumblers *A* are extended forward in the form of a flat arm, and these arms are curved laterally inward, so that their inner ends nearly meet at the center, each arm terminating with a small rounded projection on its lower side. The tumblers are in a recess which also contains the mainspring. (Referred to in the plural, as the gun is double barreled.)

To one of the projections in rear of the joint is pivoted a pendant *C*, which plays loosely in a vertical slot in the center of the front arm of the breech frame, directly in front of the converging arms of the tumblers. This pendant has a hook-shaped projection which engages under the front ends of the arms of the tumblers, so that when the rear ends of the barrels are raised the hook raises the arms of the tumblers far enough to permit the dogs *B* to engage in a notch in the tumblers, thus automatically cocking the arm,

To hold the hook *C* back far enough to engage with the

arms of the tumblers, a pin extends through a projection on the under side of the barrels. The triggers operate upon the rear arms of the dogs for firing the arm.

Ham'mer-spring. The spring of the hammer in a gun-lock. Its parts are the *play-side*, *stud-side*, the *turn*, the *flower*, the *stud*, the *eye*; through the latter passes the rod of the spring-pin.

Hand. (*Fire-arm.*) The part of the stock gripped by the hand, and which may be either *straight* or *pistol-gripped*.

Hand'spike-ring. (*Artillery.*) The thimble on the trail transom of the gun, for the handspike by which it is maneuvered.

Hausse. A lifting breech-sight of a gun.

Figs. 1329, 1330, 1331, show that of the Mauser rifle, the piece adopted by the German government. It is short and at the same time adapted for long range firing.

It comprehends the following dispositions and range: —

Nick on the breech, 200 meters.

The small rear leaf lifted (Fig. 1329), 300 m.

The small leaf folded down and the forward *hausse* raised: the bottom nick (Fig. 1330), 400 meters.

The slider raised so that its lower end corresponds with figure "5" on the left, 500 meters.

Slipping to mark "6," 600 meters.

And so on up to "10" (Fig. 1331), 1,000 meters.

The sight then shifts to the upper opening in the slider, the latter being slipped down.

The bottom of the upper opening, 1,100 m.

The top of the hausse, 1,200 meters.

The slider lifted to expose "13" on the right, 1,300 meters.

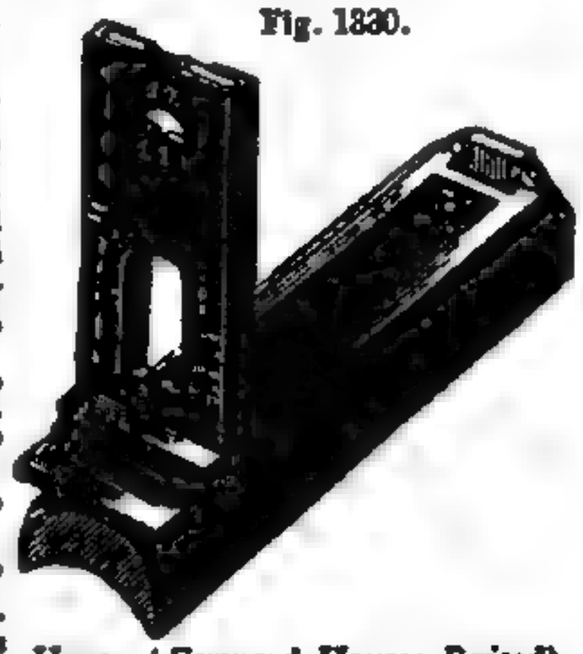
And so on up to "16" 1,600 meters, which is the position shown in Fig 1331, which is shown as set for 1,000 or 1,600 meters, by using the lower or the higher notch, for the respective distances.

Other forms are given under SIGHT.

Fig. 1329.

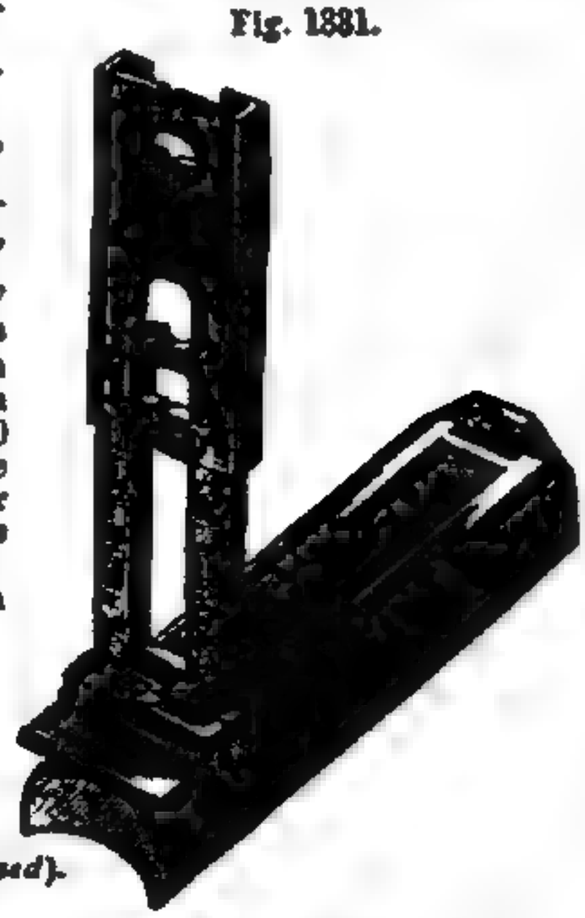
Hausse (Small Leaf Lifted).

Fig. 1330.



Hausse (Forward Hausse Raised).

Fig. 1331.



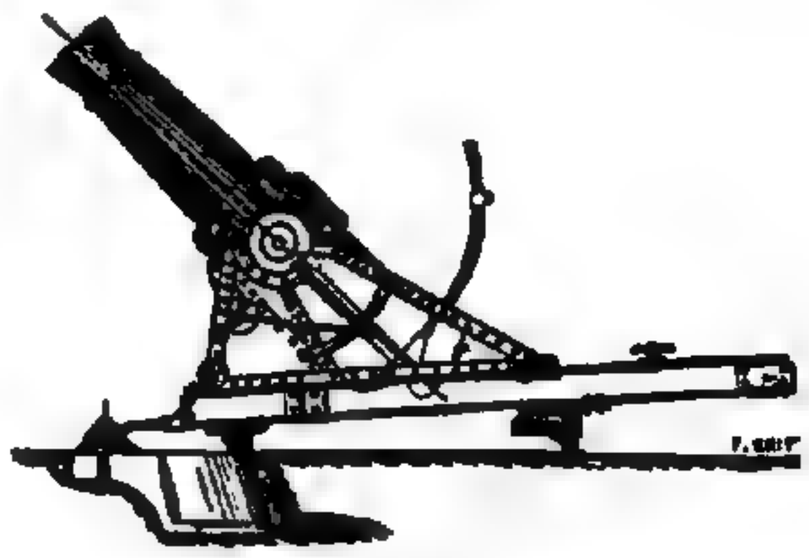
Hausse (Slider Raised).

Heel Plate. (*Fire-arm.*) The solid or skeleton plate at the butt-end of the stock. Sometimes the top and bottom are merely tipped.

Ho'bit. (*Ordnance.*) An old form of mortar of six or eight inches' bore, mounted on a carriage.

Hot-shot. Cannon-balls made red hot in a furnace in order to fire wooden structures into which they are thrown.

Fig. 1388.

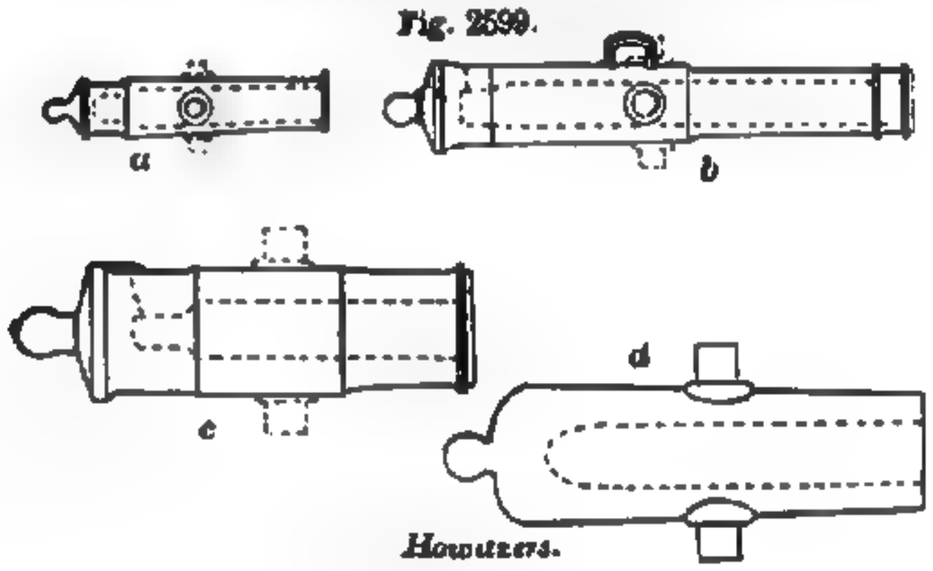


Spanish Howitzer.

How'it-zer. A cannon, differing from ordinary guns in being shorter and lighter in proportion to its bore, and used for throwing hollow projectiles with comparatively small charges. A 6-pdr. gun weighs 100 pounds more than a 12-pdr. howitzer. Their charge of powder for a 12-pdr. field howitzer is ¾ pound of powder; that for a 12-pdr. mountain howitzer is ½ pound of powder. A smaller chamber at the bottom of the bore receives the powder.

a, mountain-howitzer.
b, field-howitzer.
c, siege-howitzer, model of 1850.
d, the siege-howitzer, 1861, has a chamber the ize of the bore. See MOUNTAIN-HOWITZER.

Fig. 2599.



Howitzers.

I

Im-pres'sion Ma-chine'. (*Cartridge.*) A machine for making an impression in the head of the cup, which is done by a horizontal die pressing it into a pattern, so that, when vented, the holes will not be on the top but on the side of the impression.

In-cen'di-a-ry Com'pounds. Greek-fire, said to be the invention of Callinicus of Heliopolis, in Syria, in the seventh century. It was first used upon the Saracens' ships. It was blown out of long tubes of copper, shot out of cross-bows, and projected in other ways. It burned on water, and diffused itself on all sides.

The composition of Greek-fire was kept as a state secret in Constantinople. It is believed that it contained sulphur and nitrate of potash mixed with naphtha. See GREEK-FIRE.

The Arabs had an incendiary composition formed of sulphur, saltpeter, and sulphide of antimony, mixed into a paste with juice of black sycamore, liquid asphaltum, and quicklime.

The French engineer Chevallier, about 1797, invented a compound which would burn under water.

Shells, charged with this or a similar substance, are said to have been found on some of the ships of the French fleet which carried Napoleon and his army to Egypt, and were afterwards taken or destroyed by Nelson at the battle of the Nile.

Rock-fire is one of the best known modern incendiary compositions; it burns slowly, is difficult to extinguish, and is used for setting fire to ships, buildings, etc. For putting in shells it is cast in cylindrical paper cases, having a priming in their [illegible]

Rock-fire is composed of rosin, 3 parts; sulphur, 4; niter, 10; regulus of antimony, 1; mutton-tallow, 1; turpentine, 1. These are combined by pulverizing the sulphur, niter, and antimony separately, mixing them by hand, and passing them through a sieve; the tallow is melted over a fire, the rosin is then added, next the turpentine, and afterward the other materials; the whole being thoroughly incorporated by stirring with spatulas, and great care being taken to prevent its taking fire. When the composition becomes of a brown color the fire is permitted to go down, and when sufficiently fluid is poured into the paper cases.

Niepce experimented upon the effects of potassium and benzole, and ascertained that ½ gramme of potassium in 300 grammes of benzole would spontaneously ignite on the surface of the water, burning and spreading over a considerable surface. Petroleum may be substituted for benzole. A solution of phosphorus or chloride of sulphur, in sulphuret of carbon, also spontaneously ignites on exposure to the air.

In-cen'di-a-ry-shell. A hollow projectile charged with incendiary composition, and designed for setting fire to buildings, ships, and other objects. Hollow balls, filled with fire, appear to have been among the earliest projectiles used in warfare after the introduction of the Greek-fire, though these were not fired from cannon; but descriptions are given of balls of fire used by the Saracens in Spain, which seem to correspond closely with modern incendiary-shells. The use of incendiary compounds appears to have gradually become obsolete, as we hear little or nothing of their employment until toward the close of the eighteenth century, hot shot being used as a substitute.

About 1797, Chevallier, in France, invented an incendiary compound, which seems to have been tried to a limited extent by the French government, for filling shells. Since then, many inventors have exercised their ingenuity upon this subject, the principal object being to obtain an inextinguishable composition for charging shells, to be ignited either by time-fuse or by percussion.

The only shells of the incendiary kind generally recognized in modern warfare are CARCASSES (which see).

In-cor'po-ra'ting Mill. (*Gunpowder.*) A mill on the Chilian principle; two-edge wheels revolving in an annular pan. The materials are ground in water; say 1 gallon to the batch of 50 pounds from the mixing-mill.

See "*Ordnance Report*," 1879, Appendix I., Plate II., Fig. 5, and description on pp. 99–101.

For gunpowder, Br. . . . . * "*Engineering*," XXV. 87

In-crease'-twist. (*Rifling.*) A rifle-groove which has an increased angle of twist as it approaches the muzzle, allowing the projectile to be easily started and giving it an increased velocity of rotation as it proceeds.

Rifling was known in the seventeenth century; its inventor and date being unknown. Mere grooved barrels, without spirality, were used two centuries earlier.

The increase twist is credited to Tamisier, and dates but a few years back.

J

Jack'et-ed Gun. (*Ordnance.*) One strengthened by bands fitted or shrunk on to the tube proper. It is now a common mode of making ordnance; a good instance may be seen in the *Broadwell* gun, * "*Engineering*," XXI. 16. Also the Armstrong gun.

Jel'ly Pow'der. So called from its resemblance to calf's-foot jelly. It consists of 94% or 95% of nitro-glycerine and 5% or 6% collodion cotton, so mixed as to assume a gelatinous form. It is tough, but can be easily cut with knives or shears, and applied to cartridges and balls. It is waterproof, acts in the same way as dynamite, but is at least 50% stronger, and does not possess the great defect of the latter in parting with its nitro-glycerine when damp. — *Nobel.*

L

Lan'cas-ter Gun. A cannon with a twisting, slightly oval bore and conoidal projectile.

Lan'cas-ter Rifle. One with an elliptic rifling, the bore being slightly oval in section. The twist is one turn in 32 inches, which is the length of the barrel; bore, .498 inch; eccentricity, .01 in half an inch. The lateral expansion of the bullet causes it to fill the bore. Length of bullet, 2½ diameters with a windage of 4 thousandths, and has a paper patch, — the first of its kind. Named from the inventor.

Lance. 1. (*Weapon.*) A weapon consisting of a long shaft with a sharp point, much used, particularly before the invention of fire-arms. It was the principal weapon of the Macedonian phalanx, and the Roman infantry were armed with it as well as with the *pilum* or javelin.

In the Middle Ages it was held in the highest repute by knights and men-at-arms who formed the main strength of European armies; it was gradually superseded by the invention of gunpowder.

The lance used by knights of the Middle Ages was of a peculiar form. Near the lower end the shaft was

Lance-buck'et. (*Cavalry.*) The shoe in which the butt of a lance is carried by the troopers of certain bodies of cavalry.

Lead'ing-rod. One used in draw-boring and

polishing the bores of rifle-barrels.

Leaf Sight. A form of sight having a hinged plate, known as a *leaf*, and erected for use, but lying flatly on the barrel for safety at other times.

Light-ball. (*Ordnance.*) The ordinary light-ball, which has been in military use for centuries, consists of a canvas sack of elongated shape, filled with a combustible and illuminating composition. It is used for lighting up works in sieges, and also for discovering the position of an enemy; in the latter case it is charged with a shell to prevent its being approached, and is fired from a piece of ordnance. As from its position on the ground it can illuminate but a limited area, parachute light-balls have been proposed. That of Sir William Congreve was to be attached to a rocket. General Boxer's light-ball was adopted into the British service in 1850. It consists of a mass of sulphur, saltpeter, and red orpiment, inclosed in a hemispherical case of tinned iron, which is attached by chains and cords to a large calico parachute that is compressed into a similar hemispherical casing, the two forming a sphere, having an annular depression surrounding it. A second tinned-iron case fits over the first, and has a fuse communicating with a train of quickmatch in the annular groove before mentioned, and also with the bursting charge. This projectile is fired from a mortar.

Lig'nose. A Silesian blasting powder made of woody fiber charged with nitro-glycerine.

It is very light; burns slowly in a loose state; does not explode in contact with open fire; is three times as strong as an equal weight of black blasting powder, and less than one third the price. Mentioned in the "*Deutsche Industrie Zeitung.*" Made at Kieltah by Baron von Trutzschhier Falkenstein.

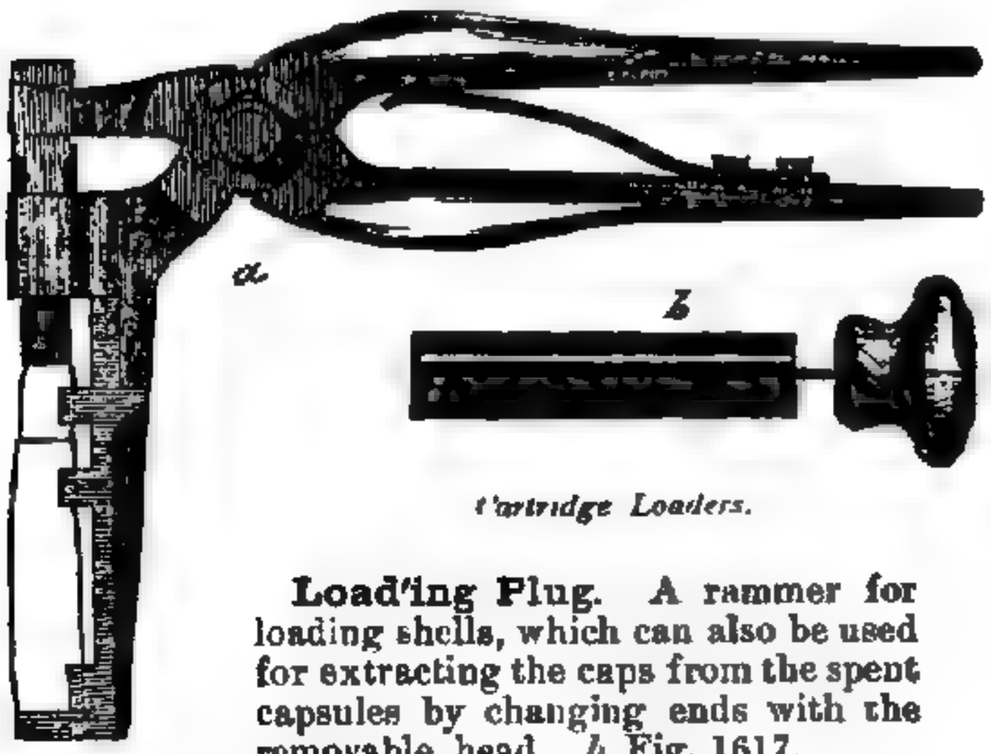
Load'er. An instrument for re-loading cartridge shells (Fig. 1617.)

The instrument *a* has a prop for the shell and a plunger for the loading, the pressure being given by approaching the handles in manner of a forcepe.

b is a powder or shot rammer, and at one end has a point which may be employed to dislodge the spent percussion shell

a and *b* are manifestly not intended for the same shell. *a* is shown compressing the bullet into a bottle-shaped shell.

Fig. 1617.



Cartridge Loaders.

Load'ing Plug. A rammer for loading shells, which can also be used for extracting the caps from the spent capsules by changing ends with the removable head. *b* Fig. 1617.

Load'ing Ma-chine'. (*Cartridge.*) A machine for loading the shells of cartridges. The shells are fed in on a revolving wheel; 72 grains of powder are let in from above by a funnel from the can, and on revolving farther the bullet is pressed into the neck of the shell.

Lock-hole. The recess in a musket-stock to receive the lock.

Lock-screw. The screw which fastens the gun-lock to the stock.

Long-bow. (*Weapon.*) A bow the hight of the archer, formerly used in England. See Bow.

Loop. (*Fire-arm.*) The projection under the barrel to which the fore end is fastened.

2. (*Cartridge.*) A machine in which the bullets after being trimmed are waxed so as to clean the gun when firing. They are covered with Japan wax, which is in a vertical tube regulated by a heavy weight keeping it against the bullets which are fed in on a wheel. The bullets are pressed out carrying so much wax with them. See Cartridge.

Lump. (*Fire-arm.*) The iron piece soldered on to the barrel, and which descends into the action (in break-joint breech-loaders) where there is a recess prepared for it.

M

Mace. 1. (*Weapon.*) A mallet, hammer, or sling-shot used in the Middle Ages to oppose warriors in armor. It had many forms: a simple iron club; a spiked club; a pointed hammer; an iron-spiked ball chained to a handle about 2 feet long. The latter were called *morning stars* by the train-bands of London; a grim pleasantry.

The Assyrian soldiers used "wooden clubs knotted with iron."—Herodotus, VII. 63.

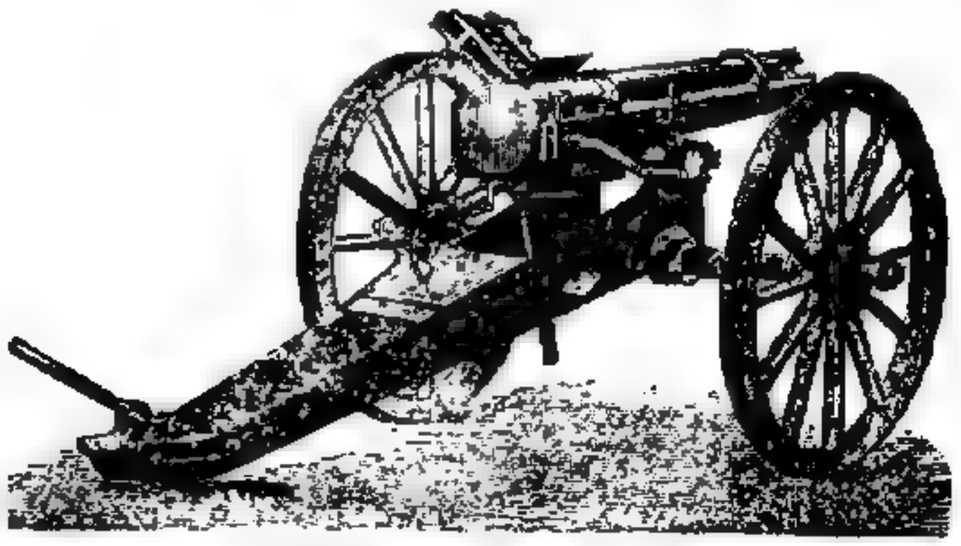
The bent mace (*lisan*) are found in the old Egyptian pictures, and are yet common in Africa and elsewhere.

In the times of the Plantagenets the mace was [redacted] in battles and tournaments, and was superseded by the pistol in the time of Elizabeth. The mace is still retained among the Turkish cavalry.

Ma-chine' Gun. One in which the loading and firing are executed by mechanical means; the power being usually applied by means of a hand-crank.

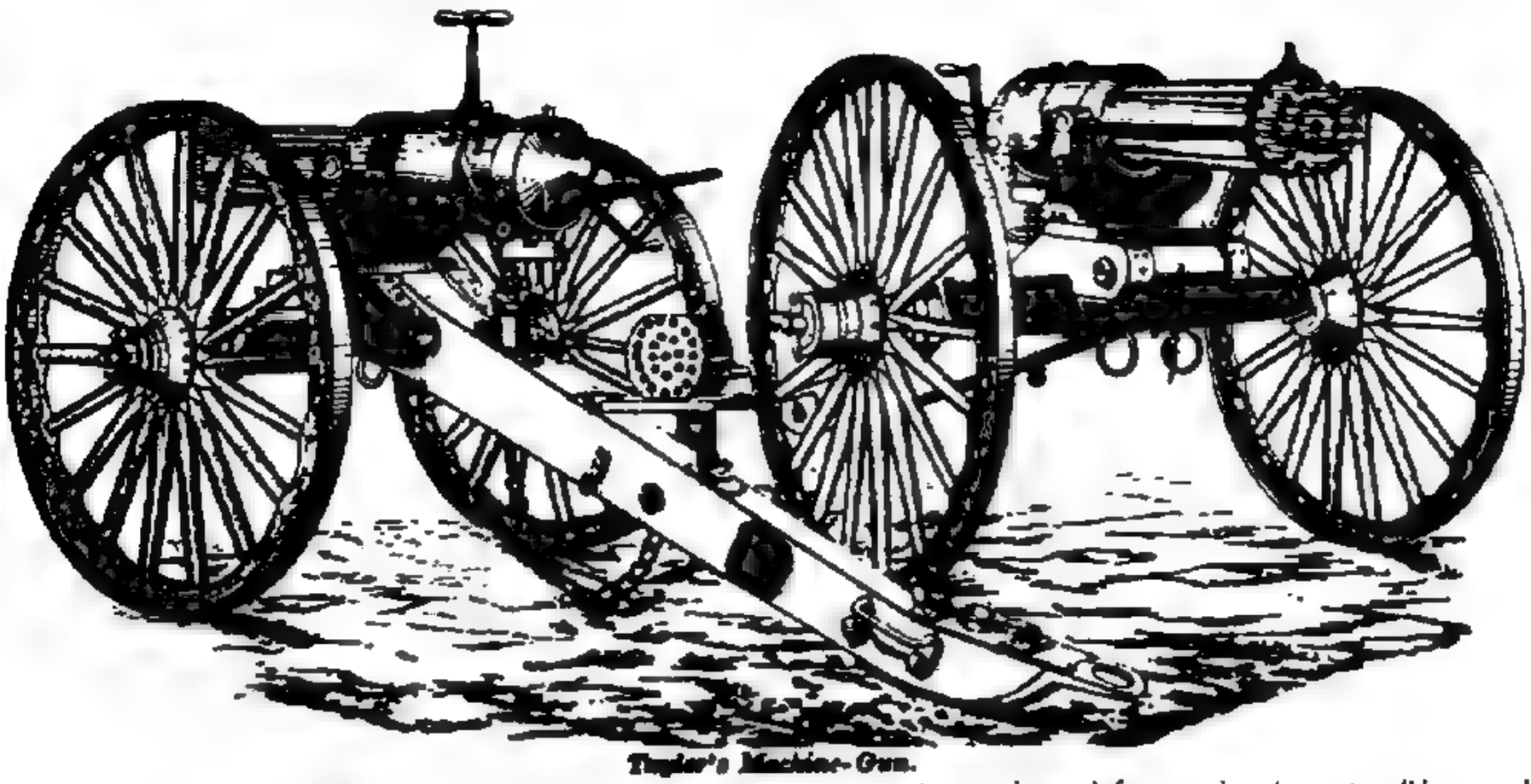
B. B. Hotchkiss's revolving cannon consists of 5 steel barrels of 1.5″ caliber, grouped about a horizontal shaft, and

Fig. 1647.



Hotchkiss Cannon Revolver.

revolving in front of a breech-block, which has openings to receive the cartridge and empty shell. The gunner, by turn-



Taylor's Machine-Gun.

Fig. 1648.

Gardner Machine Gun.

ing a crank extending from the stationary breech, causes the shaft and barrels to revolve, and, while this rotation is in progress, mechanism is operated which shoves fixed ammunition into the rear of each barrel, and then, as the loaded barrels continue their revolution, a spring plunger strikes each cartridge in succession, and each barrel is thus discharged in turn. The projectiles are percussion conical shells, weighing about one pound each, and the rapidity of fire has exceeded 100 shots per minute. As each shell on striking bursts into an average of 17 effective pieces, the above volley is equal to 1,700 bullets striking within an area of 200 square feet in the above period of time. The range far exceeds that of any small arm. The revolving cannon is made **by the inventor for the French government at St. Denis, near Paris, and is stated to be effective and accurate at 5,000 yards.**

The *Gardner* machine gun (Fig. 1648) is mounted upon tripod or upon carriage; is automatic, transferring the cartridge from the feed-port to the barrel, firing, extracting, and ejecting the empty shell, consecutively to each barrel. The barrels are stationary. The mechanisms for feeding and firing each barrel are independent: those for loading cartridges and ejecting shells are positive. The cartridges are fed automatically from a vertical magazine: the move-

ments are derived from a hand-crank. The gun has traverse motion on its vertical axis in the stand, and adjustment for altitude by hinge and screw.

The *Taylor* machine gun has 12 barrels of 2″ caliber, each having a magazine capable of holding 12 cartridges. The magazines revolve, the loading is automatic, and the gun worked by one person by means of the lever on the tail-piece.

The *Bailey* gun has a circular cluster of parallel barrels, and is worked by a revolving crank, the cartridges descending in a case which is stuck into the hopper so as to feed automatically. It has one lock, made in two pieces, which works all of the barrels.

See also *Parkhurst's* machine gun. Patent No. 228,777.

***Parnell's* machine gun consists of 10 steel barrels of .45″ caliber, arranged parallel to each other in a metallic frame. From center to center of the outer barrel is 8′. Each barrel is charged separately from a magazine containing 50 rounds of ammunition. The charging, firing, and extraction of exploded shells are all accomplished by the turning of one crank, at each revolution of which the whole 10 barrels are discharged, emptied, and reloaded. A system of cog-wheels connects the firing crank with an automatic traverse.**

It differs from the Gatling gun in the simultaneous loading and firing of 10 barrels, the latter loading each barrel through the same magazine aperture and firing but one shot at a time, though with almost incredible swiftness.

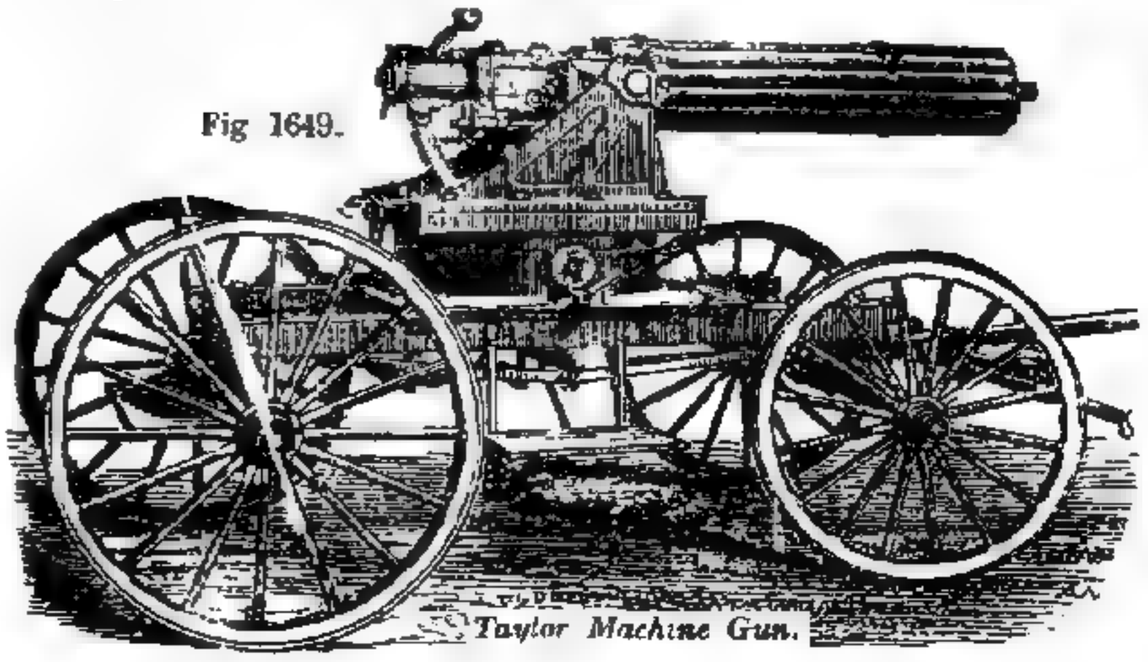
The *Requa* battery has 25 barrels lying horizontal and parallel on a carriage. It is a breech-loader, and the barrels are fired simultaneously.

The arrangement of the barrels is similar to that of the "infernal machine" of Fieschi, with which he fired upon Louis Philippe and his staff, killing several persons, but missing the king. In Fieschi's device the barrels were separately loaded, laid on a bench, clamped, and a train of powder laid over the touch-holes

In Requa's battery the paper cartridges are driven into all the barrels simultaneously by a sliding breech-block traversing at the rear of the whole platoon, and operated by a lever. Priming leads to each of the cartridges, and the charges are fired by a cap.

Two forms of the *Taylor* battery gun have the horizontal parallel (or converging) arrangement of barrels.

Fig 1649.



Taylor Machine Gun.

Mag'a-zine' Fire-arm. One containing a supply of cartridges, which are automatically fed to the chamber at the rear end of the barrel. There are several types.

1. Those in which the magazine is a tube below the barrel, as in the Winchester, the Ward-Burton, etc.

2. Those in which the magazine is in the stock, as in the Spencer, Meigs, and others.

3. Those in which the magazine is a separate piece attachable to the gun when required, as in the Elliot carbine, the Gatling battery-gun, etc. See BATTERY-GUN.

The Marquis of Worcester (d. 1667), in his "Century of Inventions," refers to an "often-discharging pistol," but does not describe it. In 1575, several of such arms were stored in the Tower of London. Porta, in his "Natural Magick," 1658, speaks of a great brass gun, or hand-gun, which may discharge ten or more bullets without intermission. The idea is to load with powder and shot alternately, until the barrel is full; an intervening "dark powder" gives an interval between the firing of the separate charges, so as to avoid the simultaneous explosion and the results which would very certainly follow.

Most of the ancient repeating-guns were many-chambered revolvers, and not what we term magazine-guns. See REVOLVER.

The Henry or "Winchester" rifle will fire sixteen shots without reloading, and the gun is cocked by the same movement of the guard that opens and closes the breech; the exploded cartridge being withdrawn and a fresh one supplied at the same time and by the same movement. The copper cartridges, fifteen in number, are placed in a tube extending the entire length of the barrel on its under side, from which they are fed into the gun by the operation of the lever-guard, a spiral spring forcing back the cartridges as fast as they are used up. The piece has been fired fifteen times in less than ten seconds. 187 shots were fired in 3 minutes and 36 seconds, not including the time required to replenish the magazine; and, including the time thus employed, 120 loads were loaded and fired in 5¾ minutes, — 1,040 shots being fired without cleaning or repairing the gun. See *Y Y'*, Plate XVIII., FIRE-ARM.

Fig. 3020 shows a longitudinal section of the breech and working parts of the magazine, with a cartridge on the carrier ready to be fed to the firing-chamber.

The Ward-Burton arm is on the bolt system. A supply of cartridges is carried in a tube *a* beneath the barrel. These are fed backward by a spiral spring. The gun is opened by raising the handle *b* of the bolt and withdrawing it. As the bolt is fully drawn back, it strikes the upright arm of the carrier, shown by dotted lines (at *m*), on the tray *c* formed by the lower arm of which a cartridge has been fed by the action of the spiral spring in the magazine-tube. The motion of the bolt brings up this tray, so that, when pushing forward the bolt again to close the piece, the cartridge may be driven into the chamber *d*, where it is fired by the action on a heavy needle or pin of a spiral spring contained in the bolt and compressed in the act of closing, during which, also, the carrier is forced down to receive a fresh cartridge from the magazine.

Projecting from the face of the bolt is seen the point of a spring hook, serving to withdraw the empty shells from the chamber, and also the end of the ejector-pin, which strikes them from below when withdrawn, and throws them clear of the gun. Near the head of the bolt is seen part of the sectional screw, which engages with a corresponding section within the gun when the piece is closed, and the handle turned down into place, and so supports the bolt against the force of the discharge. The magazine holds eight shots, which may be fired in about nine seconds; their issue may be cut off by a sliding piece; the arm may then be used as a single loader, (as shown in Plate XVII., opposite page 852), holding the magazine in reserve.

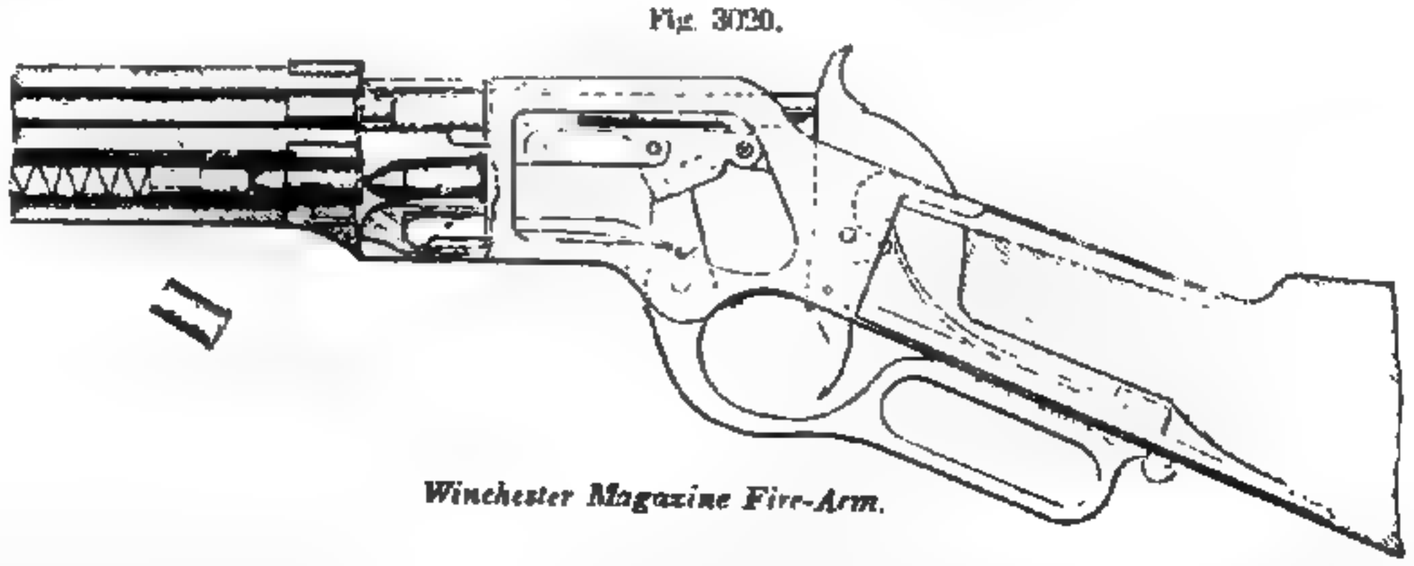
The Swiss magazine-rifle (shown on Plate XVIII., opposite page 853) has the bolt feature of the Ward-Burton, and the cartridge-loader of the Henry, so well known as the "Winchester."

The Spencer has a tube containing seven copper cartridges placed lengthwise in the stock, from whence they are forced, one at a time, into the barrel, by merely moving the lever-guard forward and back, — the shell of the exploded cartridge being removed by the same operation. The gun is then cocked and fired in the usual manner. This gun was more extensively introduced into the army, during the late civil war, than any other of its class, and is, therefore, very generally known. It is shown at *F*, Plate XVI.

The Cullen magazine-gun (Fig. 3022) has a revolving cartridge-carrier in the stock, which contains four sets of cartridges, ten in each set or column. As one column is exhausted another comes in place, so that forty shots may be fired without reloading. The operating mechanism is connected to the trigger-guard, which works as in the Spencer.

The Meigs magazine-gun, made at Lowell, Mass., contains five columns of ten each, or fifty cartridges, which were fired before the Austrian Military Committee in 16 seconds, and replaced by another magazine in a few seconds. The breech-block rises and falls by a backward and forward sliding reciprocation of the trigger-guard. When one line of cartridges is expended, the magazine is rotated on its axis by a spring bringing another line of cartridges in line with the feeding arrangement.

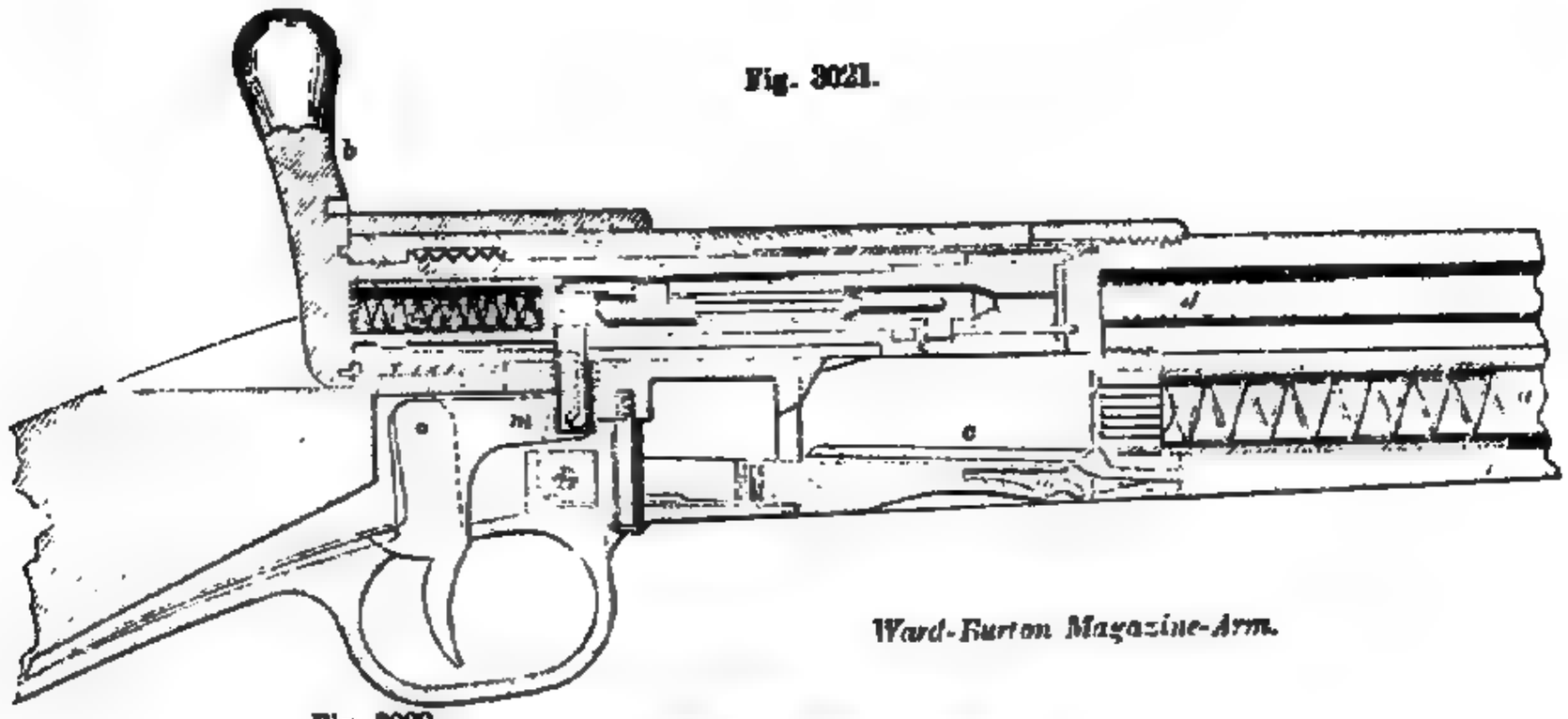
Fig. 3020.



Winchester Magazine Fire-Arm.

A number of magazine-guns carry cartridges in the stock, linked together like sausages, which are cut apart as they are used. See classification list under FIRE-ARM, pp. 854 – 862.

Fig. 3021.



Ward-Burton Magazine-Arm.

Fig. 3022.

Magazine-Rifle.

Fig. 1650.

Hotchkiss Repeating Arm.

Mag'a-zine' Gun. A gun containing a supply of cartridges, mechanically furnished to the chamber of the barrel, seriatim.

The Hotchkiss repeater is a bolt and needle magazine gun. The magazine in the butt contains six cartridges which are forced forward by a spring. The gun is shown in Fig. 1650.

The cartridges are inserted one at a time, to the number of five, pressing each backward into the chamber until a click is heard, due to the head of the cartridge passing the cartridge stop. A sixth may be placed in the chamber. To load, turn the bolt and retract it. The bolt engages a cartridge, and the return motion forces the load into the chamber and cocks the piece. The piece has the usual 4 motions: Twist, draw, return, lock. The cocking being automatic, the piece is ready to fire

Lieut. A. H. Russell's (U. S. Army) magazine gun is shown in Figs. 1651, 1652. The magazine is at the side and can be filled whether the piece be loaded or unloaded, the opening for insertion of the cartridge being accessible at all times.

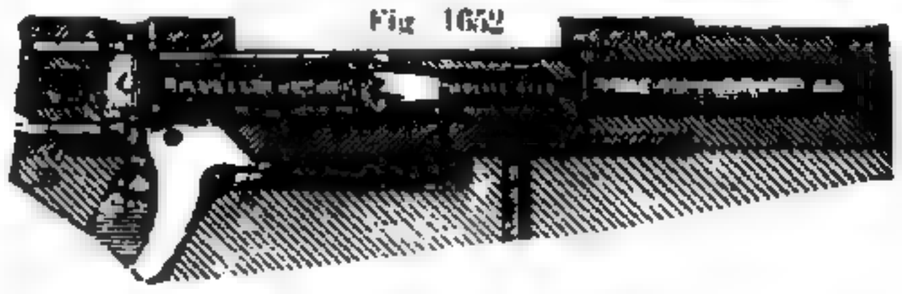
The loading is on the bolt system, but no turning of the bolt is required. Fig. 1651 shows the bolt pushed forward

Fig. 1651

Russell's Magazine Gun (Elevation.)

slightly, forcing before it a cartridge just introduced into the receiver from the magazine *L*, which holds 5 or 6 cartridges, side by side. The magazine is at the side of the receiver and extends downward to the bottom of the trigger guard. The mouth of the magazine is at the side of the receiver, and the cartridges are forced upward by a spring so as to bring them in succession to the action of the bolt. A spring-gate pre-

Fig. 1652



Russell's Magazine Gun. (Section through barrel and bolt.)

vents the escape of cartridges except to the receiver, while it allows them to be inserted sidewise into the magazine from without. They may be inserted singly, or the magazine may be filled quickly from a cartridge-box applied to the mouth of the magazine, the cartridges being forced in by the finger, the gate of the magazine yielding to the pressure from above and closing after the cartridges have entered.

The action of the bolt is rectilinear. It is drawn out by a handle which unlocks a pivoted catch-piece, *C*, to free the bolt, and relocks the piece *C* when the bolt is thrust home in loading. The forward motion of the bolt compresses the firing spring and the trigger catches in the hook of the firing pin. The breech mechanism is simple, and the operation requires merely a forward and back motion of the hand.

See also *Trabue's* magazine gun, patents Nos. 223,414; 223,660.

Report of trial of magazine arms for the French navy: —

"The French authorities have recently made a careful trial of repeating arms with a view to adoption should one be found which, while serviceable in other respects, fulfilled the following conditions, which were put forth in March, 187-: —

"(1.) To fire the regulation metallic cartridge of the army.

"(2.) To have the

same trajectory and the same accuracy as the rifle model, 1874.

"(3.) So constructed as to be used as an ordinary single shot arm, or, in other words, to admit of passing quickly and simply from single shot loading and firing to repeating, and *vice versa*.

"(4.) To be strong, not requiring too tender care, not to be exposed, from a breaking down of the repeating mechanism, to unserviceableness as a single shooter; to be dismounted, cleaned, and remounted without difficulty.

"On March 28, 1877, the minister approved of this programme, and on September 14th he sent orders to Cherbourg to experiment with three types of repeaters, with detailed instructions as to the trials. These three arms were: —

"(1.) The *Hotchkiss.* "(2.) The *Kropatschek.*

"(3.) The *Krag.*

"To these three the board confined themselves.

"The result of these trials showed that the magazine of the Hotchkiss was most quickly charged. The Hotchkiss also fires most rapidly; both in repeating and single shot fire the Kropatschek was not far behind it. The Krag does not seem to have been well understood and manipulated by the men.

The Kropatschek — modified — with eight cartridges in its magazine beat the Hotchkiss which had only six, while the Krag with nine cartridges was best of all. The time necessary to discharge this latter arm's magazine of nine rounds was 24.87 seconds, in which time the Kropatschek had on an average fired 8.9 cartridges per arm, and the Hotchkiss 7.9 starting with the magazine closed; with the magazine open 25 seconds were occupied, in which time the Krag fired 9, the Kropatschek 9.3, and the Hotchkiss 8.25 rounds on an average. Single shot fire proved better than recharging the magazine and repeating continually. The minimum times taken to fire off the magazines, at the conclusion of the experiments, when the men were expert, were as follows: Hotchkiss, 6 rounds, in 10 seconds: Kropatschek, modified, 8 rounds, in 14 seconds; Krag, 9 rounds, in 17 seconds; giving an average time per round of 1.66, 1.75, and 1.88 seconds respectively.

"Finally, it was concluded that the Hotchkiss rifle is the easiest and quickest in charging the magazines; then the Kropatschek: and last, Krag. As to rapidity of fire, the Hotchkiss and Kropatschek are about equal. Large magazines have a great advantage; the magazine once empty, it is best not to attempt to refill it till leisure gives the opportunity." — "*Engineer.*"

Match-lock. The form of gun-lock which preceded the wheel-lock and the flint-lock. It had a match, whence its name, which was presented to the priming. Still used in some parts of Asia. See REVOLVER.

Mar'tin's Shells. (*Ordnance.*) Cast-iron spherical shells, lined with loam and cow-hair and filled with molten iron. Used as an incendiary shell.

Mealed Pow'der. Gunpowder pulverized treating with alcohol.

Me-tal'lic Car'tridge. One in which the charge is contained in a metallic capsule, in contradistinction to the paper cartridge. See CARTRIDGE.

Min'ie-bul'let. Invented at Vincennes by M. Minie about 1833. See BULLET, c, Fig. 969.

Mi'trail-leur'. (*Fire-arms.*) A French form of battery-gun which is loaded at the breech, by a block containing pockets for a number of cartridges. These are fired consecutively or in a volley. Charged plates are kept in reserve.

The object is to obtain greater accuracy and range than are attainable by the case or canister shot, discharged from cannon. These are contained in an envelope which is ruptured either by a bursting charge within or by the force of projection, and have consequently a tendency to scatter over a considerable area. The mitrailleur, or machine-gun, on the contrary, sends a large number of small projectiles independently, and with precision, to a considerable distance.

The infernal machine with which Fieschi attempted to assassinate Louis Philippe in 1835, and succeeded in killing eighteen persons, including Marshal Mortier, and wounding a large number of others, besides severely injuring himself, was one of the earliest attempts with which we are acquainted for producing a simultaneous discharge from a number of gun-barrels. These were arranged side by side on a bench or stand, and fired by a train, much as in the mode of firing barrels in a proving-house.

That first tried in the French service was made by removing part of the breech from a brass field-piece and inserting twenty-five rifle-barrels, open at both ends, into the bore; these extended back, so that their rear ends were flush with the face of that part of the breech in front of the opening, into which was inserted a case having a number of cylindrical openings equal to that of the barrels, and filled with cartridges; from these, by means of an equal number of plungers operated by a hand-screw, the cartridges were forced into the barrels; the charging-case was then removed, and replaced by a firing-block provided with a lock and pin for each cartridge, by which they were successively fired on turning a cylinder in the firing-block.

A later form of the weapon is shown in Fig. 3183. It has 37 barrels, and ammunition-chests alongside the gun on the same axle. The 37 cartridges, intended for one charge, are contained in a small box. A steel plate with corresponding holes is placed on the open box, which is then reversed, and the cartridges fall points foremost into their respective holes. They are prevented from falling through by the rims at their bases. The loaded plate is then introduced into the breech-slot, and when the breech is closed by a lever, a number of steel pins, pressed by spiral springs, are only prevented from striking the percussion arrangement in the cartridges by a plate in front of them. When this case is moved slowly by a handle, the cartridges are fired one by one. If the plate be withdrawn rapidly, they follow each other so quickly that their discharge is all but simultaneous.

The projectile weighs 37 grammes, or a little over an ounce. The charge of powder is from 6 to 8 grammes. The last amount is that counseled by the inventors.

The mitrailleur of 37 barrels weighs 180 kilogrammes, or 400 pounds, without the carriage, and can be worked by two men. It was found, however, at Vienna, in December, 1869, that to obtain the most rapid firing, or 481 balls per minute, five men were necessary to work the piece.

The front carriage contains from 48 to 56 boxes for loading, and the two caissons hold 16 breech-plates furnished with cartridges. The mitrailleur is, therefore, provided with 2,368 cartridges; and a battery of 8 mitrailleurs can hurl on an attacking column 3,843 effective projectiles per minute.

Another form of battery-gun employed by the French in the war with Germany consists of a series of barrels arranged side by side, the muzzles slightly diverging, and loaded at the breech by means of a rectangular breech-block containing two rows of chambers, one above the other. The cartridges are inserted into the upper row of chambers; the breech-block, which turns on an axis, is partially revolved, bringing the loaded chambers in line with the barrels, and the machine is fired, while at the same time the empty row of chambers is loaded; and these operations are repeated continuously. The machine was intended principally for defending the flanks of a column or line, or the angles of a square. It has no carriage, but is mounted upon a light frame of

Fig. 3183.

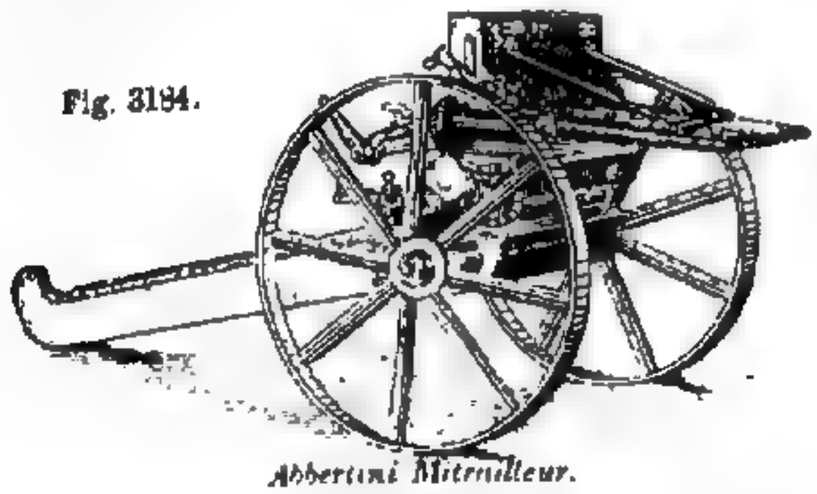
French Mitrailleur.

iron, with a pair of hinged legs in front and another in rear, which are locked in position for firing by a hinged brace, and which serve as handles for transporting it from place to place, two men performing this operation.

The Billinghurst and Requa battery, an American invention, consisting of 24 rifle-barrels arranged on an axle, and capable of parallel or diverging fire, was in use in the United States service in 1861.

The Abbertini, one of the forms of this weapon in use in Europe, has ten barrels similarly arranged; the working of the machine being performed by a crank which, through intermediate devices, conveys the cartridges to the barrels from the box-like magazine at the rear of the barrels upon the mounted frame or carriage. The barrels, after each discharge, are

Fig. 3184.



Abbertini Mitrailleur.

cleaned by special appliances; the entire number of barrels can be discharged from eighteen to twenty times a minute.

Hotchkiss's mitrailleur is a bundle of rifled cannon, throwing explosive shells weighing 23½ ounces at the rate of 60 in 48 seconds. It is mounted and rotated like the Gatling gun, but the loading and firing apparatus differ from the latter. It has been tried experimentally in France and Italy.

Taylor's machine-gun is shown at Fig. 3185.

The charging-blocks, one of which is shown on the shelf on the trail of the gun, are filled with cartridges automatically from a magazine carried in the caisson, the magazine having chambers corresponding with those in the charging-block, and containing springs to press the cartridges forward. The rear view shows the gun open to receive the charge. The handle, seen in a vertical position, is attached rigidly to a sleeve, which has a concentric reciprocating movement of about 90°, and imparts a longitudinal movement to the breech-block and escabel by means of studs projecting from the interior of the sleeve into spiral grooves in the sliding breech. The charge-block being inserted, the handle is drawn down into horizontal position. The rotation thus imparted to the sleeve closes the breech-chamber, slides the breech forward, pressing and locking the block firmly against the rear of the barrels, and, by means of plungers projecting from the front of the breech, forcing the cartridges partially through the block and into the barrels. The front view shows the arm with its breech closed in readiness for firing. The discharge may be effected simultaneously in all of the barrels by depressing the longitudinal lever which projects backward from the breech, and carries a pawl adapted to catch and suddenly release a sliding hammer concealed within the escabel. The hammer is then driven forward by springs, striking all the firing-pins at once. The barrels can be discharged in succession by means of the crank shown at the side of the breech. This crank rotates a tappet or cam-wheel arranged to retract and release all the firing-pins in succession. The barrels are arranged in concentric circles at back, but diverge slightly forward so as to spread the fire in a horizontal plane.

The empty cartridge-shells are held by the charge-block and withdrawn with it.

Morn'ing-star. A weapon used in ancient times and as late as by the train-bands of London, in the time of Henry VIII. It consists of a ball with spikes, united by a chain to a staff.

Mor'tar. A short gun with a large bore, used for throwing bombs. Said to have been used at the siege of Naples in 1435, and to have been first made in England in 1543. A colossal mortar constructed by Mallet was tried at Woolwich, October 19, 1857, with a charge of 70 pounds of powder, and it threw a shell weighing 2,550 pounds 1½ miles horizontally, and about ¾ a mile in hight.

Shells of 1,000 pounds are said to have been thrown into the citadel of Antwerp, 1832, when it was taken by the French in the war of the Revolution, 1830–32.

Mortars are constructed with a chamber of smaller diameter than the bore, for containing the charge of powder, which is poured in loose. Thin, tapering slips of wood, termed splints, are used for fixing the shell accurately in the bore, no sabot being employed.

Mortars in the United States service are divided into three classes, sea-coast, siege, and coehorn. To these may be nominally added the stone mortar, which is, however, only employed in regular sieges; none, we believe, were ever cast in this country. This and the Coehorn are of brass; the sea-coast and siege mortars of cast-iron. The two former classes are made upon the same general model, differing only in relative length and thickness of metal. The chambers of all are semi-ellipses, having their minor axes of the same diameter as the bore of the mortar.

The 13-inch sea-coast mortar (*a*) weighs 17,000 pounds, and its shell about 200 pounds.

The 10-inch light mortar (*b*) weighs about one ton, and throws a shell of 88 pounds.

The Coehorn (*c*) weighs 165 pounds, and its shell 24 pounds.

The length of bore of mortars seldom exceeds two or three calibers, and is often much less. They are intended for firing shells at high angles of elevation, generally 45°, the crushing and explosive power of their shells falling from great hights being relied on for destructive effect. They are principally used in sieges for destroying buildings, blowing up magazines, etc., and for keeping an enemy under cover within his bomb-proofs, reaching him where direct shots would fail to penetrate. Four sizes of iron mortars are used in the United States service, 8 and 10 inch "light" and 10 and 13 inch "heavy." The two former can be readily transported on wagons contrived for the purpose, and may accompany an army in the field; but the latter, in consequence of their great weight, are more particularly designed for permanent positions or for use on shipboard. The 13-inch was much employed in this way during the Rebellion, and on board the mortar-schooners fully demonstrated its efficiency, under favorable circumstances, in the operations against the forts below New Orleans. For firing, mortars are mounted on beds, at present made of wrought-iron in our service, resting on platforms of stout scantling and plank, no ordinary carriage being capable of resisting the immense downward shock of even a light mortar fired at a great angle with a full charge of powder.

Stone mortars are of large caliber, from 10 to 22 inches, and have a small chamber. They are light in proportion to their size, to admit of shifting from one part of a fortification to another, and are intended for firing baskets of stones at very short ranges, or, in place of stones, 6-pounder or other small spherical case-shot may be used. They are specially designed for use in the attack and defense of fortified places when the besiegers have succeeded in establishing themselves very close to the works. We are not aware of any instance of their employment in recent warfare.

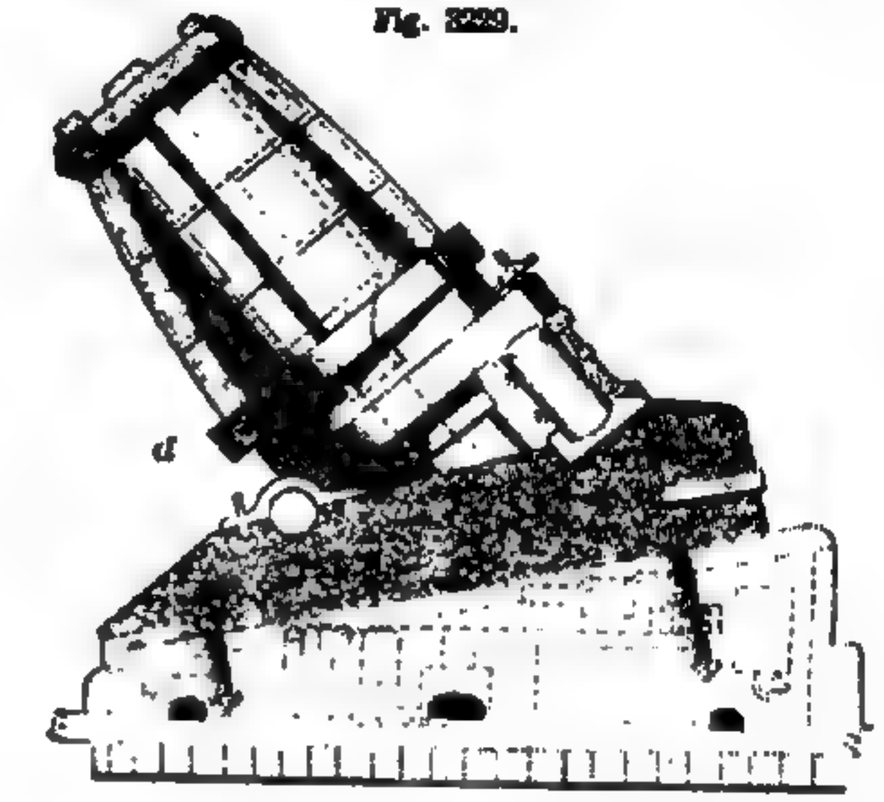
Coehorns (*c*) are small mortars, likewise intended for attacking and defending fortifications. They are made light enough to be carried from one spot to another by hand as required, and generally carry a 24-pounder shell with a maximum charge of ½ pound of powder, though they are sometimes smaller.

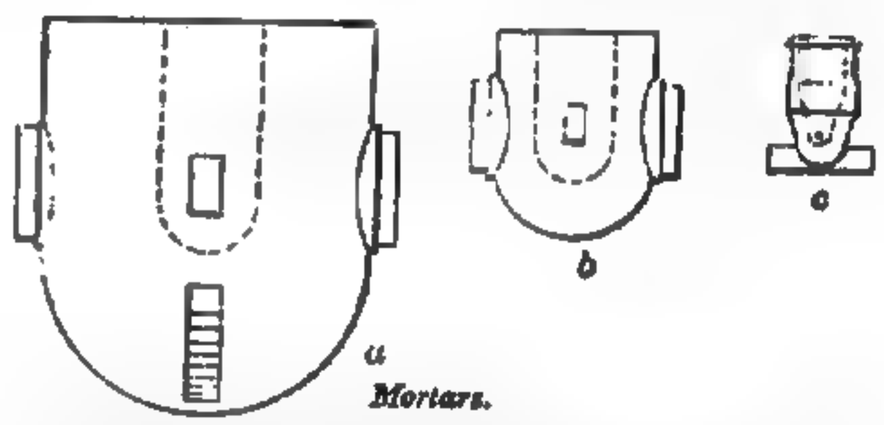
That employed in the United States service is of brass, 24-pounder caliber, and weighs about 160 pounds. It is mounted on a wooden bed, having four handles at its sides, by which it can be readily carried by four men. It derives its name from the celebrated Dutch engineer officer Coehorn, to whom the invention is attributed. See COEHORN.

In some European services much smaller mortars than these are recognized, weighing no more than 15½ pounds, and attached to a stock.

A small mortar of this kind was invented by Captain Goodwin of the United States service, and threw a shell with great effect in an experiment at the Washington Arsenal, 1864.

Fig. 3229.





Mortars.

Coehorns are, owing to their lightness and portability, very efficacious in dislodging an enemy from covered positions.

During a war waged by the English against some of the Maori tribes of New Zealand, about the year 1843–44, one of the native chiefs with his forces intrenched himself in a "pah" or corral on the top of a hill, whence the means in the hands of the troops failed to dislodge him. In this emergency an engineer officer was dispatched to Sydney and caused twelve small mortars to be constructed, which effectually accomplished the desired object.

These were carried by men to within a few hundred feet of the "pah" to be attacked, and pitched their shells into the heart of the camp.

With a charge of 8 ounces of powder these mortars were found capable of throwing a 5-inch shell 550 yards.

The mortar, of gun-metal, weighed 65 pounds, and the bed, of cast-iron, 28 pounds; this was fixed on a piece of 2-inch plank, 24 × 16.

When loaded, the shell projected half-way beyond the muzzle of the piece.

The chase of Mallet's great mortar (*d*, Fig. 3229) is formed of short cylinders or compound rings; the chamber being of wrought-iron let into a huge mass of cast-iron. Each of the two lower rings is composed of seven rings, and each set of these again of three smaller rings rabbeted together; the top

ring consists of five rings, each composed of three smaller rings rabbeted together.

There are two light rings acting as a sort of key-ring for the six bolts or staves, the bolt-head resting on the muzzle-ring and secured with steel collars in the cast-iron mass around the breech-piece.

The weight of the whole without bed is 42 tons.

Weight of bed, 8 tons.

Weight of shell, 24 cwt.

Caliber, 36 inches.

Charge of shell, 480 pounds of powder.

Cost of shell, charged, about £25.

Length of chamber, 2 feet 6 inches.

Bore at top of chamber, 18 inches.

Bore at bottom, 14 inches.

Length to top of chamber, 8 feet.

With a charge of 70 pounds of powder, a shell weighing 2,395 pounds was thrown 2,759 yards, burying itself eight yards in the ground on its fall.

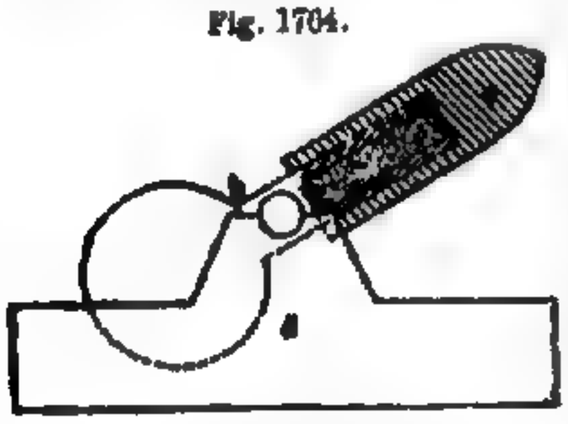
The monster mortar employed by the French at Antwerp in 1832 had a total length of 4 feet 11 inches; its outside diameter was 39½ inches; caliber, 24½ inches; length from top of chamber, 27 inches; depth of chamber, 19 inches; diameter of chamber, 9 inches. The weight of the mortar was 14,700 pounds; that of the bed, 16,000 pounds; of the empty shell, 916 pounds; and the bursting-charge, 99 pounds.

The chamber would contain about 30 pounds of powder, but 12 pounds were found to project the shell to a distance of 800 or 900 yards.

This monster affair burst with a charge of less than 20 pounds of powder after a few rounds firing.

Among the largest mortars on record are those of the island of Malta. "The rocks here are not only scarped into fortifications, but likewise into fire-engines or artillery to defend those fortifications; being hollowed out in many places into the form of immense mortars. These mortars they fill with cantars of cannon-balls, shells, stones, and other deadly materials; and if an enemy's ship should approach with a design to land, they fire the whole into the air. The effect of this tremendous invention must be very great, as it will produce a shower for 200 or 300 yards around, and would make great havoc among a debarkation of boats. A cantar is about 100 pounds weight; and as the mouths of some of these mortars are 6 feet wide, they will throw, according to calculation, 100 cantars each."—*From an account written just before the submission of the island to General Buonaparte*, 1798.

Fig. 1704.



Mortar.

a. Projectile in section.
b. Mortar.
c. Powder chamber.
d. Bed.

Fig. 1704 is a section of a small Austrian rifle mortar in which the projectile covers the outer part of the mortar. The embraced portion is a hexagonal spiral, like a Whitworth bolt, and the projectile is of corresponding shape, and fits it like a cap, and slips off when fired. The counterbalance, *b*, is to give preponderance to the rear of the trunnions.

Prussian rifled mortar of 21 cm. "*Ordnance Report*," 1878.

Moun'tain-how'it-zer. A light field-piece, of large caliber in proportion to its weight. It is mounted on a light carriage which may be drawn by one horse.

The howitzer and its carriage may each be packed on the back of a horse or mule.

The piece shown in the cut is a gun of the howitzer battery made for the negro contingent in the Ashantee war, just concluded. Sir Garnet Wolseley's dash on Coomassie is something of which to be proud.

Moun'tain Gun. (*Ordnance.*) A light cannon capable of being transported on mule back. For this purpose it is detached from its carriage and the weight distributed among several animals.

The Ashantee gun is shown in Fig. 8242, p. 1486, "*Mech. Dict.*"

Mountain-Howitzer (*Ashantee Expedition*, 1873-74).

The new Woolwich mountain guns, made from the designs of Sir William Armstrong, instead of weighing merely 200 lbs., like the mountain gun used in Abyssinia and Zululand, will weigh 400 lbs. each. As, however, an essential condition of mountain artillery is that every part of it shall be carried on the backs of mules, these guns are made in two pieces, screwed together, and strengthened at the joint by a third piece in the shape of a ring or collar. The breech end of the gun when disjointed weighs 200 lbs., and the barrel with collar amounts to about the same weight, which is regarded as a fair burden for a mule over hilly country. These guns, like their smaller namesakes, are of the small caliber adopted for 7-pounder projectiles, but their greater length and weight enable them to do much more effective work.

Mus'ket. (*Fire-arms.*) The fire-arm of the infantry soldier. It superseded the arquebus, on which it was an improvement. Formerly, smooth-bore and muzzle-loading, modern progress has improved it into the rifled breech-loader of the present. See FIRE-ARMS.

Mus'ket-oon. A short musket used by cavalry and artillery previous to the introduction of breech-loaders.

Mus'zle-sight. The *front-sight*, screwed into the swell of the muzzle of a gun or the muzzle-band of a howitzer. It is made of iron or steel, and is equal in hight to the *dispart* or difference between the semi-diameters of the base-ring and muzzle.

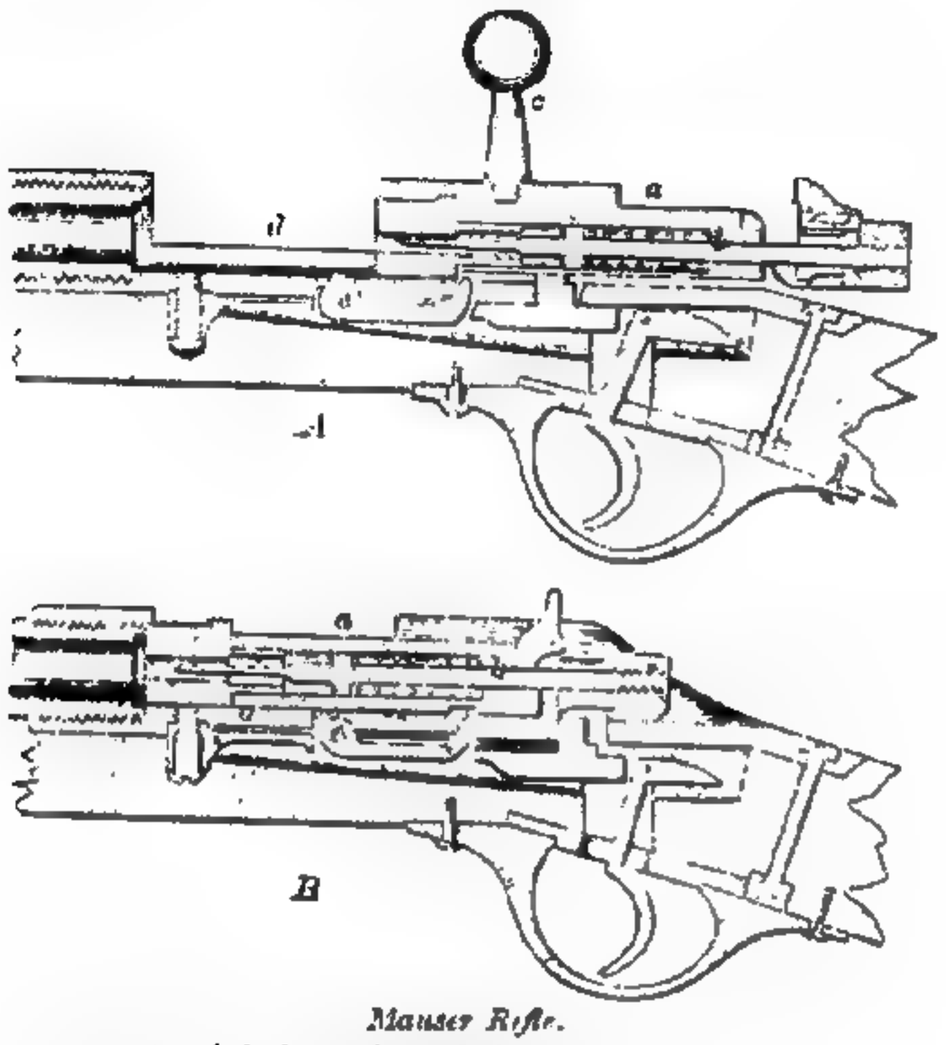
N O

Nail-ball. (*Ordnance.*) An iron ball with a tail-pin projecting from it, to keep it from turning in the bore of the piece.

Nee'dle-gun. (German, *Zündnadelgewehr.*) A fire-arm which is loaded at the breech with a cartridge carrying its own fulminate, and which is ignited by a *needle* or pin traversing the breech-block and struck by the hammer.

There are many guns of this construction, such as the converted Enfield (see CONVERTING); but the one which has attained

Fig. 3308.



Mauser Rifle.

so great celebrity, though by no means the best of its class, is the Prussian needle-gun, which performed so effective a part in the Prusso-Austrian war of 1866. See FIRE-ARM, cut *C*, Plate XVI. The French chassepot-gun is shown at *B*, same plate.

The Prussian piece was invented by Mr. Dreyse, who is said to have spent over thirty years in trying to construct a perfect breech-loading fire-arm.

It was introduced to some extent into the Prussian service about 1846, but was much improved afterward. It has since been superseded in the North German army by the Mauser rifle (Fig. 3308). *A* shows the breech mechanism in position for loading, and *B* at half-cock.

The breech-piece *a* is perforated to receive the needle *b*, and is operated by the lever *c*, by which it is turned quarter round and drawn backward, retracting the needle until a catch thereon drops into a notch by which it is retained until released by the action of the trigger, when it is driven forward by a spiral spring.

An extractor works in a groove at the side of the shoe *d*, withdrawing the cartridge-case when the breech-piece is drawn backward. This movement brings the case in violent contact with the ejector *e*, by which it is thrown out.

A Berlin correspondent of the London "Times" gives an account of the performance of this new arm: "On a distance of 1,500 metres (1,640 yards), out of 480 shots, 399 hits were effected in five targets placed behind each other; and on 1,400 metres (1,564 yards), out of 480 shots, 460 hits are reported."

Nip'ple-seat. (*Fire-arm.*) The *hump* on the side of a barrel on which the nipple is screwed and through which the fire is carried to the charge.

Nip'ple-wrench. (*Fire-arm.*) The spanner with sides which fit the square of the nipple, and which is used for screwing it to and unscrewing it from the barrel.

Ni'tro-gel'a-tine. An explosive agent invented by Nobel; formed by dissolving gun-cotton in nitro-glycerine, with camphor added in varying proportions, nominally 4 per cent. See BLASTING GELATINE, p. 105, *supra.*

Ni'tro-gly'cer-ine. *Nitroleum, glonoin,* or *blasting-oil.* Discovered by Sobreso, professor of applied chemistry at Turin, in 1847, and introduced into this country in 1864 by Nobel, a Swedish engineer.

An oily liquid of a specific gravity of 1.6, having a sweet aromatic taste, colorless when pure, but, as manufactured, it is usually light yellow. If heated up to 100°, no change takes place; heated gradually to 193°, it is decomposed, losing its explosive power. When not under pressure it burns quietly. Heating when confined may create a partial decomposition, and an explosion from the pressure thus generated. An electric spark will pass through it without causing explosion unless a series of sparks are passed through it until decomposition is caused and heat generated. Fire alone ordinarily will not explode it. Jarring nitro-glycerine, even when at a temperature of 50° C., will not explode it. Explosions occur: 1. When confined and heated to 180° C.; 2. If struck so as to create heat and pressure; percussion causes it to explode with difficulty when frozen, which takes place at 8°, but striking it when in that state with a sharp hard substance, as a pick, will then easily explode it. — *Journal of Applied Chemistry.*

It is prepared by successively adding small quantities of glycerine to a mixture of nitric and sulphuric acids and pouring the compound into water, when the nitroleum, which is insoluble in and heavier than water, falls to the bottom of the vessel.

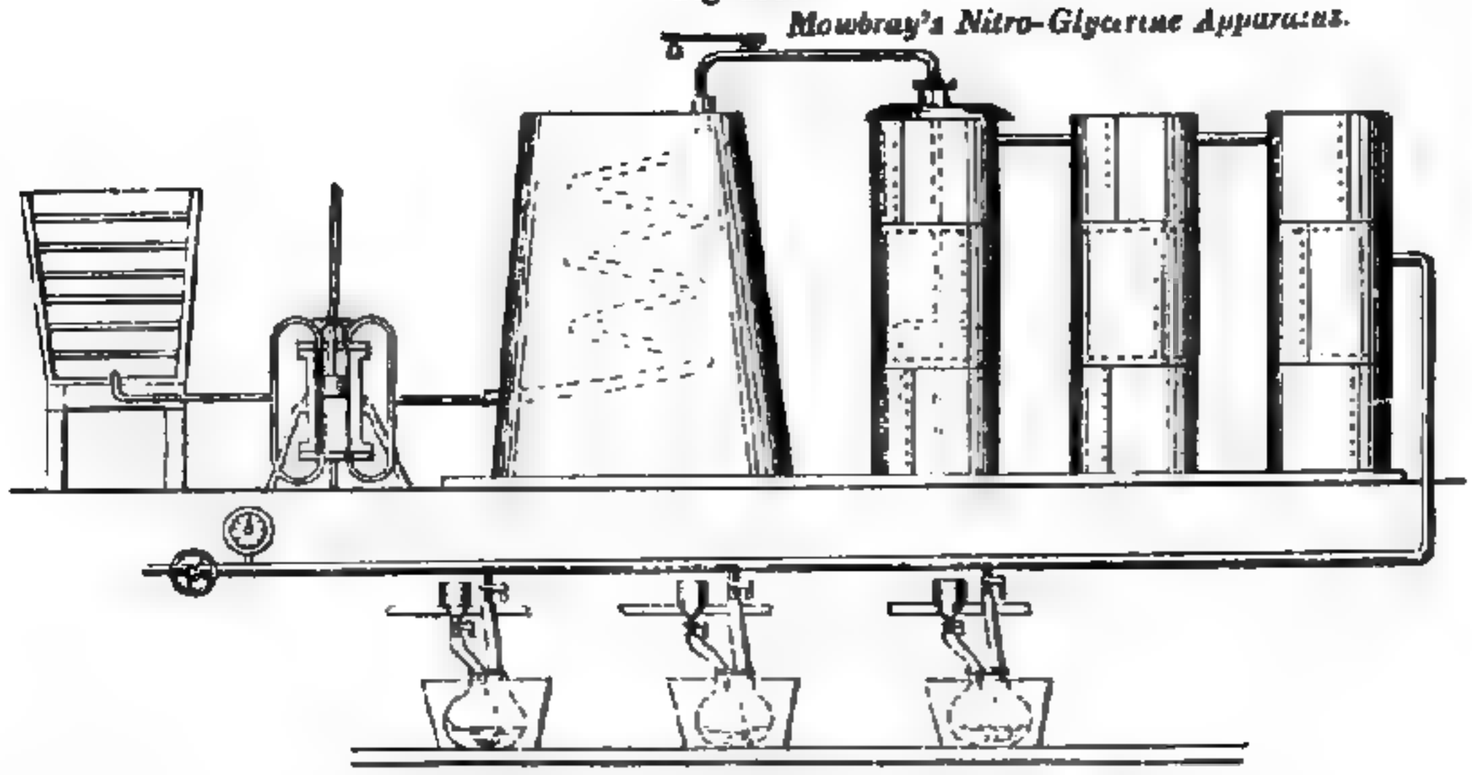
The acids used should be of the purest quality, and great care taken to avoid the introduction of foreign matters; otherwise slow decomposition, which may finally result in spontaneous explosion, occurs. For this reason it is better to have it made on the spot and used soon after making.

It may be purified by dissolving it, very gradually and at a temperature not exceeding 50° F., in sulphuric acid, and separating the nitroleum by the gradual addition of nitric acid, and then pouring, in a fine stream, into pure cold water from which the air has been expelled by boiling; in the preparation the temperature of 50° should in no case be exceeded.

In Mowbray's process, a current of cold, dry air is passed through the vessels in which the compound is made, for carrying off the hypo-nitrous acid and to cool and agitate the mixture.

Fig. 3330.

Mowbray's Nitro-Glycerine Apparatus.



The vessels are lined with glass.

This substance has been extensively used for blasting purposes; in the Mt. Cenis and Hoosac tunnels, the operations at Blossom Rock, harbor of San Francisco, in the improvements of the East River, New York, and elsewhere. (See BLASTING; TUNNEL.) Developing about ten times the explosive power of gunpowder, it requires far less drilling and operates so as to lift the rock from its bed without shattering it to such an extent. The number of fatal explosions resulting from it have been an obstacle to its more general use, but these are claimed to have resulted generally from improper manufacture, exposure to too great heat in transportation, or carelessness in handling.

Among the most prominent accidents occurring from these sources were the explosions at Aspinwall and in the office of Wells, Fargo, & Co. at San Francisco, by the former of which forty-five and by the latter six lives were destroyed. In the case of the Aspinwall disaster the nitroleum had been shipped from Hamburg, where the temperature was 55° or 60° to a tropical climate where the temperature in the hold of the steamer was probably more than double this. It was inclosed in cork-stopped vessels, packed in cases with sawdust. The explosion has been attributed to the disengagement of gas, which, by the corrosion of the corks, escaped into the surrounding sawdust, forming a new and easily ignited compound, which, becoming mixed with the undecomposed nitroleum which escaped, was easily exploded at such a high temperature by the rough handling to which it was subjected by the stevedores. The sheriff, surveyor, and four other persons were killed by an explosion at Newcastle on Tyne, England, while engaged in burying some cases of this compound in a pit beyond the city limits for safety.

It is noticeable that most of the accidents recorded have occurred in moving, transporting, or liquefying the compound after congelation, and not in blasting.

O-blique' Fire. (*Fire-arms.*) **That shape of action in which the plunger lies and strikes the ignition obliquely, that is, not parallel with the axis of the barrel.**

Ob'tu-ra'tor. (*Add.*) 2. (*Ordnance.*) A gas check in a breech-loading piece; a Broadwell ring, for instance.

O'pen Bead Sight. (*Rifle.*) Also known as *aperture* sight. See BEAD SIGHT.

O'pen Sight. A sight, *through* which the object is viewed. See list under SIGHT, where many examples may be found, as also pin, fin, and globe sights which are not *open*.

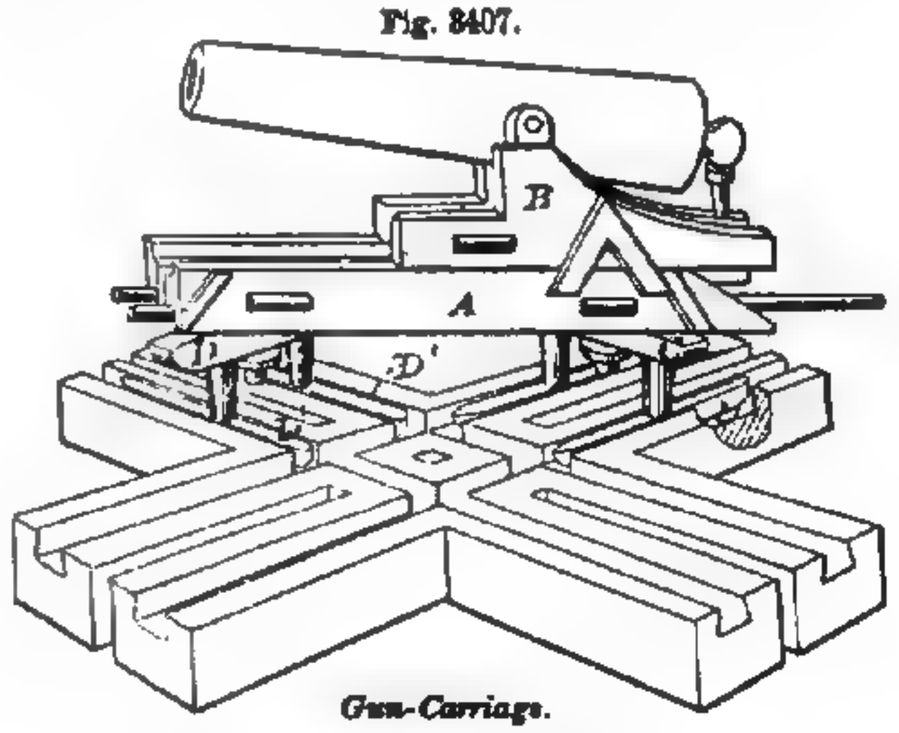
Ord'nance. A class of fire-arms too large to be fired from the person. See CANNON; MORTAR; BATTERY-GUN; HOWITZER; etc. See list under WEAPONS.

When hawks were supplanted by fire-arms, the names of the birds of prey were transferred to the new weapons.

Mosquet, a sparrow-hawk, became mousquet.
Fauçon, a hawk, was a heavy piece of ordnance.
Terzuole (Ital.), a hawk, was a small pistol, etc.

Fig. 3407 shows a form of timber carriage by which a gun may be trained to all points of the compass, without being pivoted or placed on a circular track. The foundation, or chassis, is composed of timbers framed together in the form of a cross, and having grooves *D' D'* cut in their upper surface. In these grooves the legs of bolsters *C D* run on casters, or slide on greased runners. The bolsters support the bed *A*, on which the carriage *B* slides

Fig. 3407.



Gun-Carriage.

out and in. The plan of mounting is adapted for use in earthworks and extemporized fortifications.

Ericsson's gun-carriage, Fig. 3408, is for working guns on shipboard in rough weather, and is designed to check the movement of the carriage instantly, either in its recoil, or when swayed by the motion

of the ship. *A* is the gun-carriage, and *B*, a slide-frame on which the carriage runs. *H* is a wheel with cogs on its periphery, which runs the gun out and in by means of gears worked by lever *L*. *M* is a nipper on the side of the carriage, which serves to lock the lever *L* and stop the motion of the gun in case of a lurch of the ship.

Several devices are in use to take up the recoil of guns, by rubber or spiral metallic springs, compressed air, etc.

Some of the gun-carriages devised by Captain Ericsson, and in use on the monitors, are so easy of operation that in case of necessity one man can manipulate a gun weighing 25 tons. See TURRET.

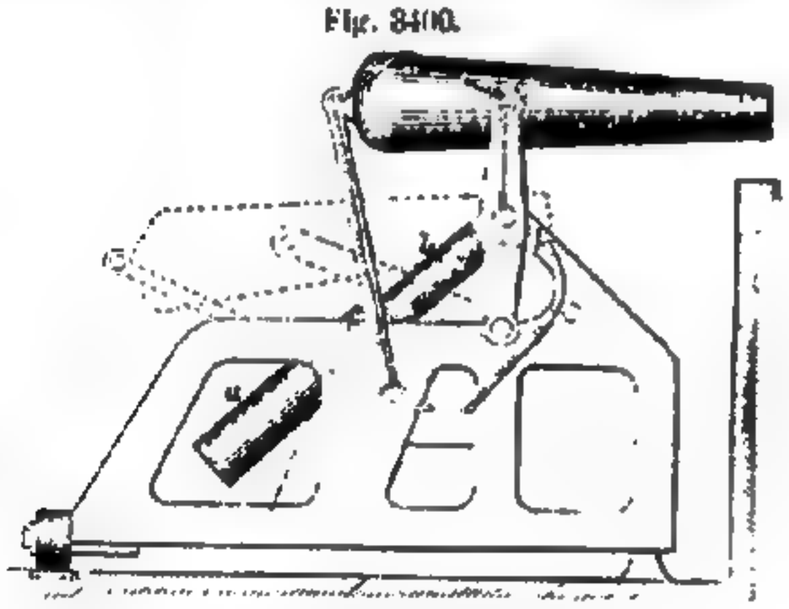
Stevens's mode of operating heavy guns, designed to obtain security for the gunners while loading, is by elevating the breech and depressing the muzzle, until the piece stands at an angle of 30°, or thereabouts. The charge is then inserted through a hole in the deck, if on shipboard, or from below the top of the parapet, if mounted in a fortification *en barbette*. For heavy guns the rammer is worked by steam-power.

This plan of loading was tried on the "Naugatuck," a small iron-clad presented by Mr. Stevens to the United States government. The Parrott gun mounted on this vessel burst while she was engaged with the Confederate forts on James River. The disaster was supposed by some to be the result of the manner of loading, as affording the shot a chance to slip forward after being driven *home*.

Eads's system of working barbette-guns consists in removing the piece bodily below the parapet while loading, and only elevating it to position at the moment of firing.

Fig. 3409 shows a carriage for operating a gun in this manner. The recoil of the gun when fired compresses air in cylinder *a* by the pressure of piston *b*. When the piece is loaded, a valve is opened which allows the restoration of the gun by the expansion of the air.

Fig. 3409.



Eads's Gun-Carriage.

Steam or water pressure may be substituted for that of compressed air. The carriage is trained horizontally in the usual manner, whether the gun be in a raised or depressed position.

Fig. 3410 is a plan of elevating heavy shot to the gun-muzzle. The ball is placed in a cradle upon a telescopic stem, which is extended by internal steam-pressure from below. As it rises, the yoke on the cradle catches below the muzzle of the gun, the front stop is depressed, the pivoted cradle tilted, and the ball rolls into the bore of the gun.

Fig. 3411 is a plan for operating guns, in which the piece may swing about the muzzle, as a pivot, when the gun is in battery, so that a port-hole about the size of the muzzle may be sufficient.

In the figure, the chassis and carriage are moved by revolution of the crank-shaft 6. To elevate or depress the breech, the hollow screw-collar *m* on the shaft *d* is thrown into gear, and by lever connection the breech is swung upward. The collar *m* is left out of gear, and the chassis and carriage swung sidewise, still retaining the muzzle as a pivotal point.

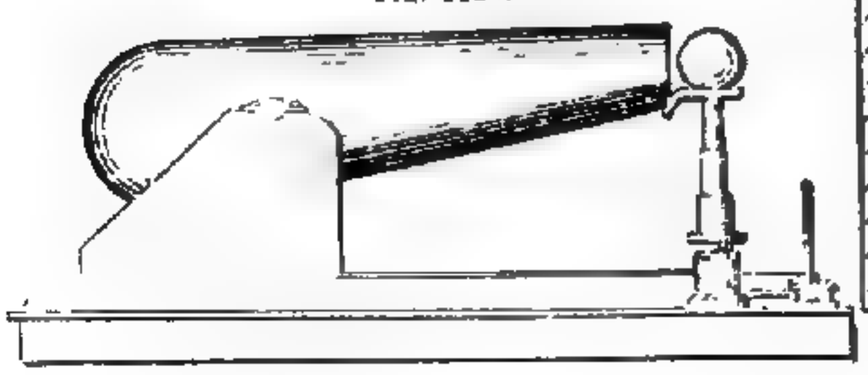
a is the shield through which the port-hole is made.

Winan's mode of loading guns on gunboats is illustrated in Fig. 3412. The gun-carriage is formed in two parts, the upper section swiveling upon the lower sections, and is supported on an adjustable chassis, the whole being raised and lowered by steam-power, and also supported on hydrostatic cylinders *D D*, which control the descent of the platform and its carriage. Sliding hatchways are opened and closed by the raising and lowering of the gun-platform. The vessel has no port-holes, and the gun *A* is lifted above the bulwarks when it is to be fired.

Moncrieff's counterpoise-carriage elevates the gun above its parapet by the weight of the front part of the cheeks. The upper and forward part of the carriage is made very heavy, and rocks in its seat when the gun recoils. See GUN-CARRIAGE.

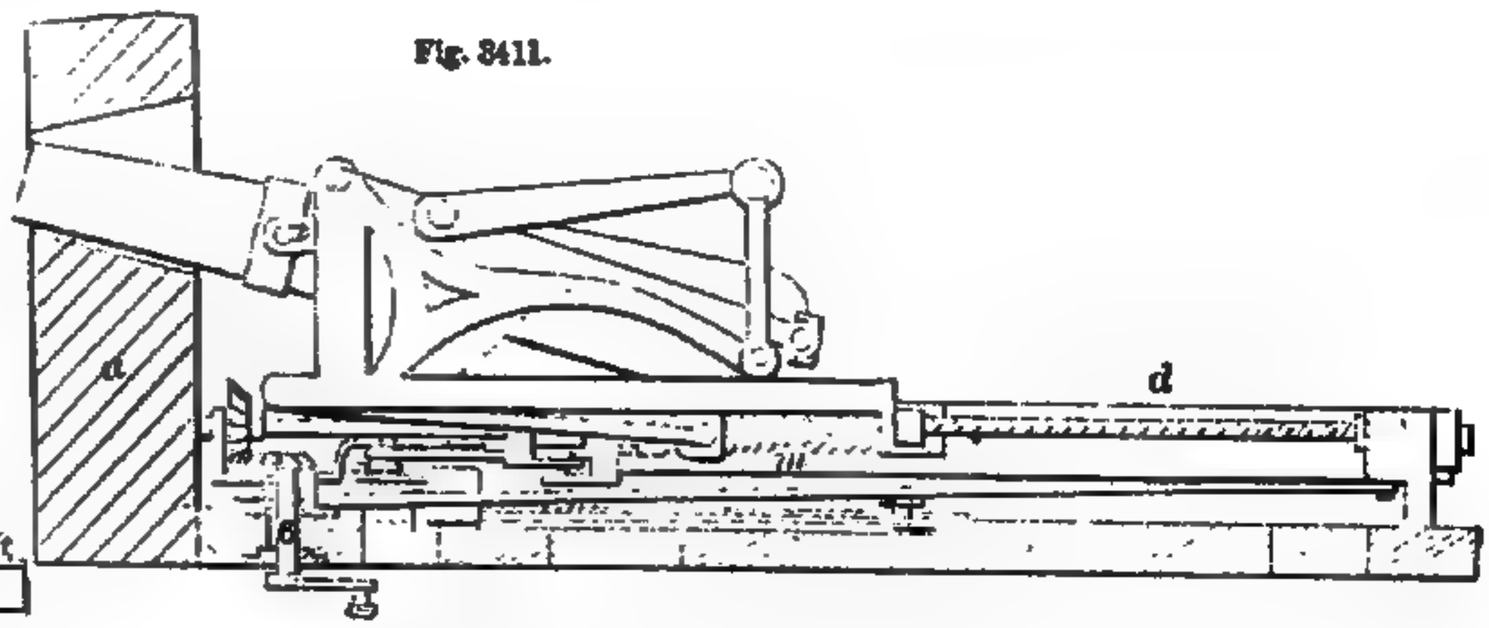
Fig. 3413 shows a mode of operating heavy guns, invented by Mr. Perley of New York. The weight of gun *g* and carriage *f* is borne by a hydraulic piston, working in a cylinder below. The recoil of carriage *f* expels water from the water-chamber at the rear, and when water is forced back into this chamber by the pumps, the gun is simultaneously run forward and the breech raised to its proper position for firing.

Fig. 3410.



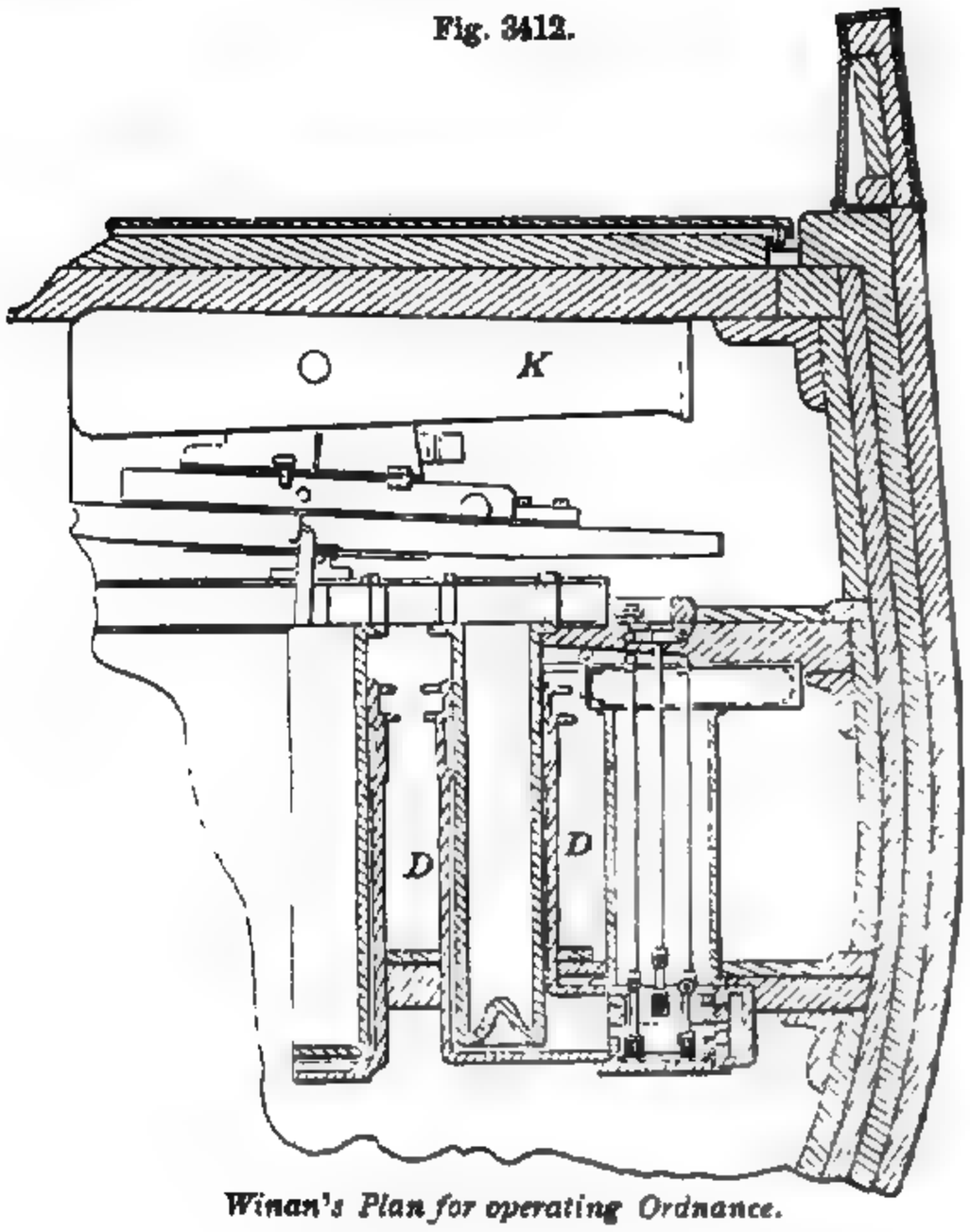
Ball-Elevator.

Fig. 3411.



Eads's Ordnance-Operator (Minimum Port-Hole).

Fig. 3412.



Winan's Plan for operating Ordnance.

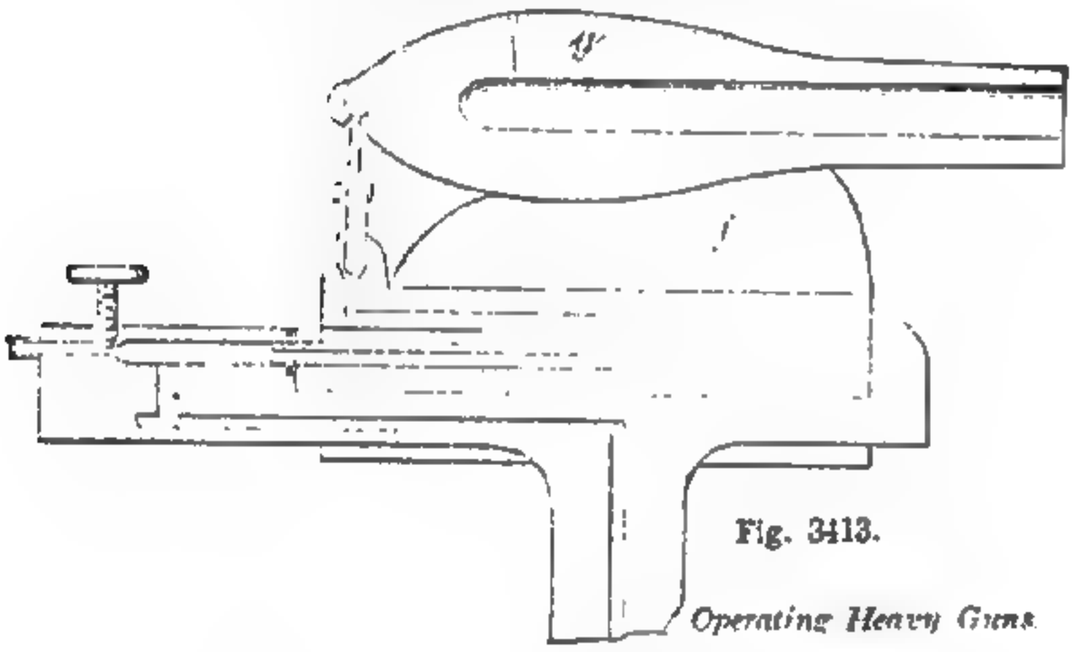


Fig. 3413.

Operating Heavy Guns.

P

Paix'han Gun. A large chambered shell-gun, so called from Colonel Paixhan of the French army, who introduced it in 1822.

Guns of this kind of the caliber of 8 and 10 inches, known as sea-coast howitzers, formerly constituted a part of the armament of coast fortifications in the United States. These differed from the *columbiad*, invented by Colonel Bomford, United States army, about 1812, in being lighter in proportion to their caliber and in having no elevating rack on the cascabel, and have been superseded by ordnance of more modern forms. See CANNON.

Peb'ble Pow'der. Gunpowder in large grains or masses. comparatively slow-burning. Cube powder; *poudre brutale.*

Pebble powder is usually formed from dense cake ¾″ in thickness by breaking it into rectangular prisms and then into cubes, by consecutive operations, the length of the faces being equal to the thickness of the cake. It is also made as large as 11-16″ to 2″ cube.

See "*Ordnance Report*," 1879, Appendix I., p. 128, and

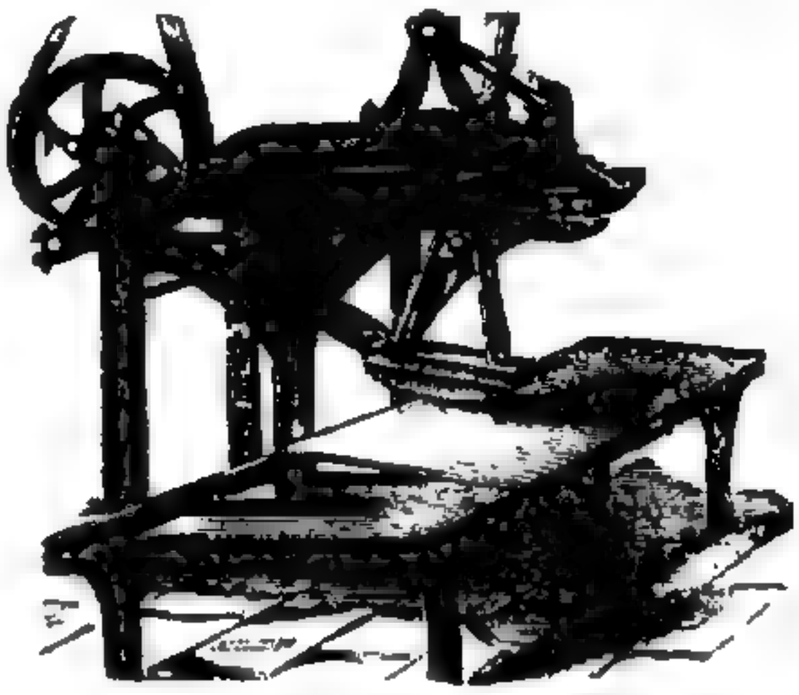
ENGINEER, September 16, 1870.

Peb'ble Pow'der Ma-chine'. A machine for making cube gunpowder.

The machine is composed of two fluted bronze rollers, each 6″ in diameter, placed about 0.5″ apart, their axes being horizontal and parallel. The teeth formed on the roller by fluting it are 0.5″ apart. The rollers revolve in opposite directions, and the corresponding teeth of the two rollers pass the place joining the axis at the same time. The cake is 14″ × 15″, and is fed vertically between the rollers which break it into right prisms 14″ long with square bases. These fall upon a board, and fed by strips on endless band to a second pair of toothed rollers which break it into cubes.

The result is sifted to remove crushed fragments and dust. The cubes are dusted and are rounded off in the glazing operation, which is done in barrels holding 400 lbs each. The barrel makes 40 revolutions per minute, and 0.5 oz.

Fig. 1888.



French Pebbling Machine.

black lead is added for each 100 lbs. 40 minutes is required for the operation.

Peep Nick'ing Ma-chine'. A special gun tool which forms the peep in the leaf of a rifle sight.

Peep Sight. A form of hind sight for rifles. It has an opening through which the muzzle sight is lined upon the object.

Pel'let Pow'der. A form of British cannon powder in which each pellet is molded of a given quantity of mealed powder.

Various shapes have been tried: disks, prisms, and cylinders; the latter preferred. The shape is a right cylinder with a circular base and a small hemispherical cavity at one end. Size 0.5″ long, .75″ diameter; weight, 95 grains. The molds are bored holes in a bronze plate in which a gang of bronze pistons work by hydraulic power.

Pebble powder has superseded it, or largely so.

In France the following are the adopted sizes: —

14 centimeter gun from .275″ to .393″.

19 to 24 centimeter gun from .51″ to .63″.

27 centimeter gun from .63″ to .787″.

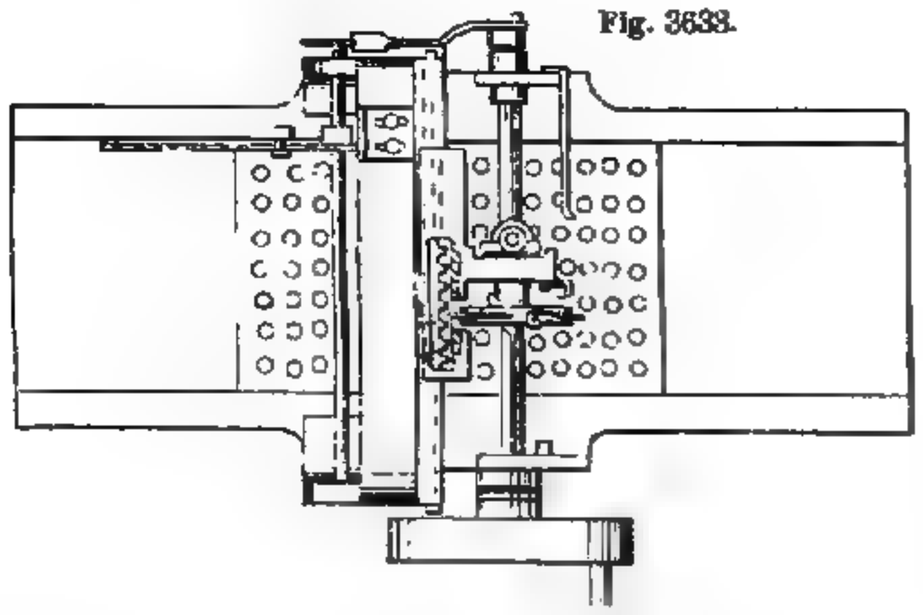
Pel'let-pow'der Ma-chine'. (*Gunpowder.*) A machine in which the powder is compressed into molds of determined shapes.

"*Ordnance Report*," 1879, Appendix I., Plate V., Figs. 11, 12, and described on pp. 126, 127.

Dr. John Anderson's machine for this purpose is shown at Figs. 11, 12. p. 196, vol. xxv., "*Engineering*." See also PEBBLE POWDER.

Per-cus'sion-cap Fill'ing-ma-chine'. The metallic bodies of percussion-caps are placed in perforations in a plate, open end upward. A plate with corresponding but smaller perforations is placed on a flat table, and damp fulminate brushed lightly across it till the perforations are filled. This plate is then placed over the empty caps and the powder shaken down into them. The charged caps are then passed to a machine similar to Fig. 3633, in which

Fig. 3633.



Percussion-Cap Filling-Machine.

the punch moves on a stationary guide across the plate, and, entering each hole, lines the caps in succession with the tin-foil, the plate being moved as each row is completed. A second punch may be used to apply a drop of varnish after the lining is in place.

Fig. 3634 shows another form of machine for the same purpose. The cap-bodies are placed in perforations near the circumference of the circular disk *J E*, which revolves on a pivot, so as to bring the caps successively under the punch *D*, which descends through a sheet of tin-foil, cuts the lining from the same, and affixes it within the cap. By a combined apparatus the caps are automatically varnished.

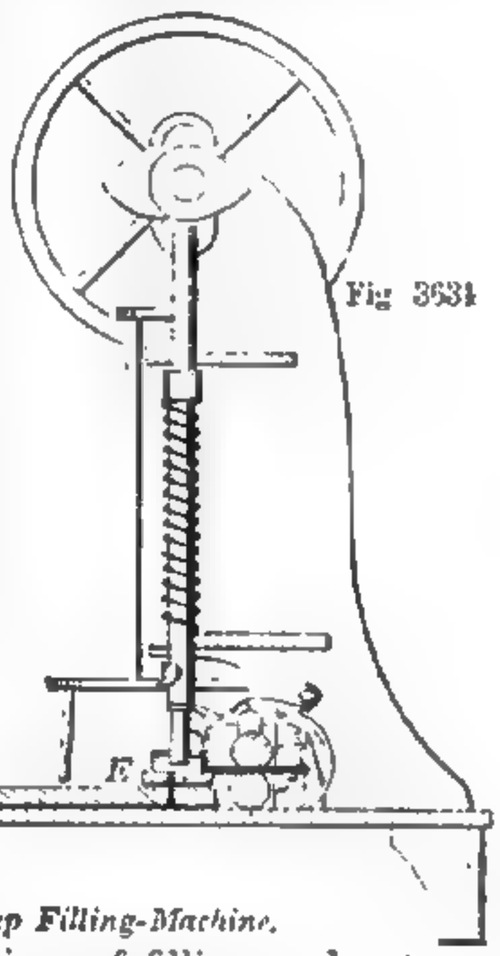
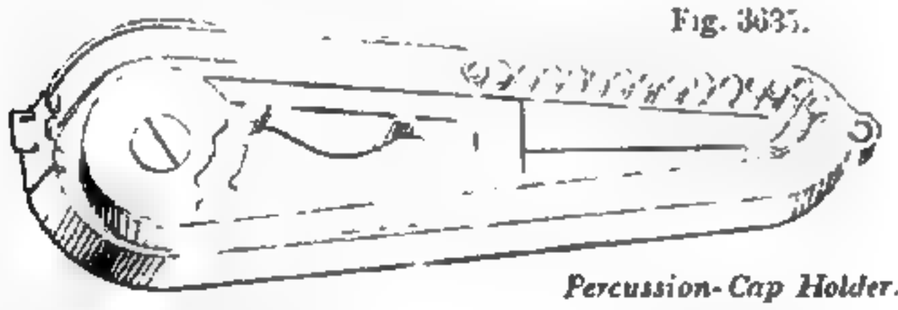


Fig. 3634

Percussion-Cap Filling-Machine.

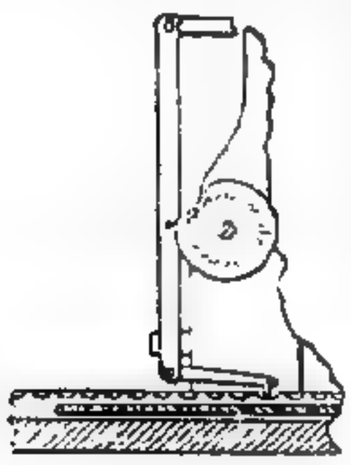
The fulminate is kept wet during the operations of filling, and not more than twelve ounces of the composition is allowed in an establishment at one time.

Fig. 3635.



Percussion-Cap Holder.

Metallic cartridge-shells are primed with fulminate and varnished in the inside in the same way as caps, but the tin-foil is generally dispensed with. The separate caps for Parker's and Maynard's, and some other central-fire cartridges are made in the same manner as gun-caps, but the shells are shallower. They are inserted in depressions in the head of the cartridge, the head of the cap on a line with the surrounding shell and forming part of the head of the cartridge.



Per-cus'sion-cap Hold'er. A sportsman's device for holding caps in such way as to be readily attached to the nipple of the piece. The caps are arranged in a groove and fed toward the opening by a spring. One is always presented at the point of discharge in convenient position to be slipped over the nipple, and then withdrawn from the case by a pull. The next in series immediately assumes the place at the opening.

Per-cus'sion-cap Trim'ming-ma-chine'. For trimming the edges of cap-bodies after they have been formed by the dies.

The caps are placed in perforations in a plate and passed beneath a rotating cutter-disk to trim the edge. Fig. 3636 shows a machine of this character, in which *b* is a bearing for shaft *c*, which carries the cutter *i*. *e* is a pulley round which the driving-belt passes, and *l* is a gage or lever to raise and depress the cutter-shaft, so that it may operate on the caps as they are brought beneath the cutter.

Fig. 3636.

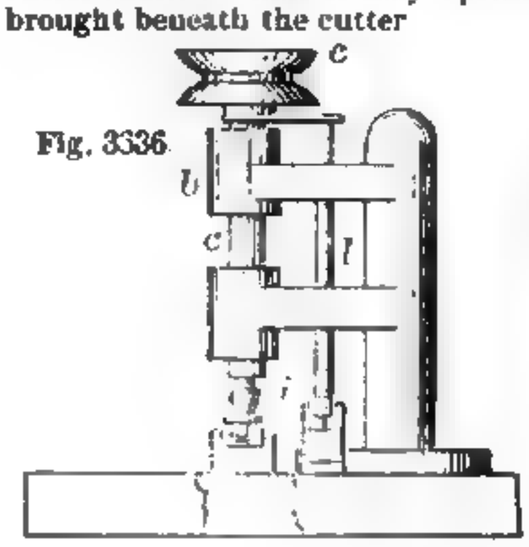


Fig. 3637.

Percussion-Cap Trimmer.

Per-cus'sion-fuse. (*Ordnance.*) A fuse in a projectile set in action by concussion when the projectile strikes the object.

Percussion-Fuse.

In the example, *A* represents a shell. A plunger *h* held by a spring *i* and detent *o*, which engages in a notch at its rear end, is released by withdrawal of the detent occasioned by the shock of impact, and strikes a nipple *g* on which is a percussion-cap.

Per-cus'sion-lock. (*Fire-arm.*) One in which the *cock* or hammer strikes a fulminate to explode the charge.

The percussion principle was first applied to fire-arms by the Rev. Mr. Forsyth of Belhelvie, England, in 1808.

The interior mechanism may be the same as that formerly used in the flint-lock, the shape of the hammer being altered to allow it a greater sweep, and the *battery* and *pan* replaced by a *nipple* or *cone*.

Per-cus'sion-pow'der. An explosive ignited by percussion. See FULMINATE.

Pe-tard'. A box or bag filled with powder, used for blowing open gates, doors, etc. It is provided with a slow-burning fuse, and to produce any considerable effect should be charged with at least twenty pounds of powder. The effect is increased by loading the petard with sand-bags or other weights. A shell of large caliber may be used for the same purpose.

The effect of petards is nearly proportional to the square of the charge of powder they contain.

Disks of gun-cotton, designed to be simply attached to a stock, drawbridge, gate, or barricade, have lately been used with great effect upon experimental structures.

Powder or gun-cotton petards are placed in position for firing in the manner shown in fig. 3652, in which the petard is laid against the stockade which it is desired to breach, resting upon timbers to give the petard greater resistance. A simple way of

Fig. 3652.

Petard.

holding the bursting-charge to its work is by a diagonal brace with its upper end holding a powder-bag against the barrier, and the other resting in a slight depression in the ground

The invention is ascribed to the Huguenots in 1579. Those first used were of metal, in the shape of a hat, and were employed to blow up gates or other barriers, and also in countermines to break through the enemy's galleries. The petard was formerly fixed to a plank called a *madrier*. Cahors was taken by Henry IV., by means of petards, in 1580.

Pet'ro-nel. A grade of cannon in some services, 6-inch bore and 24-pound ball.

Pike. A shaft of wood armed at the end with a sharp metallic head. A spear. A weapon used in repelling boarders. A *boarding-pike*.

In all times down to the invention of the bayonet it has formed a weapon for infantry in line or in mass. After the invention of the bayonet it was, for a time, mingled with the bayonets It is not now to be found in the armies of Europe in the hands of infantry.

Pis'tol. A form of fire-arm adapted for use with one hand. The modern form of pistol is a breech-loader, using metallic cartridges.

It is said to have been invented at Pistoia, in Tuscany, by Camillo Vitelli, in the sixteenth century. The German cavalry seems first to have used them, and their use caused the lance to be abandoned. At the battle of Ivry, 1590, it appears that the French gentlemen of the king's army lost ground by the change, finding it difficult to meet the charge of the enemy's lancers without taking open order and — scattering.

The general appearance of the pistol is so well known that the weapon hardly needs description here.

About 1857, those for the United States cavalry were furnished with a detachable butt-piece fastened to the butt of the pistol by a screw, so that the arm could be fired from the shoulder; the weapon, with this addition, was termed the pistol-carbine. It was soon entirely superseded by Colt's and other revolving pistols See REVOLVER.

The dueling-pistol of the last century was a finished weapon, having a long, slim barrel, and fired by a hair trigger. The stock and barrel were generally inlaid with silver. Much pride and pleasure were found in their possession and curious modifications, — *saw*-handles and *cross* handles, and so on. Rifling for pistols was not generally adopted until some time after it had been used in long-barreled guns

The Derringer pistol, which has some celebrity, is short-barreled, of very large caliber, and has been compared to a pocket-howitzer It is a very effective weapon at short range. The latest pattern of Derringer is a single barreled breech-loader, weighs about 8 ounces, and carries a half-ounce ball.

Toy pistols have been made which project a buckshot with considerable force by the explosion of a percussion-cap. Toy pistols for firing an arrow by the force of a spring, or projecting a cork by the expansion of air which has been previously compressed in a chamber, are also common.

The earliest form of pistol was used by the English cavalry in 1544. The earliest form of revolving, cylindrical breech, whose chambers are brought consecutively in line with the barrel, is found in the English United Service Museum, and is supposed to date from the time of Charles I.

The Colt pistol, which has attained the highest celebrity, was introduced from the United States into England in 1853. See REVOLVER.

The English cavalry-service pistol has a length of 13¾ inches; barrel, 8 inches; weight, 40 ounces; caliber, .577 inches; rifling, 5 grooves, having one turn in four feet.

Pis'tol-car'bine. (*Fire-arms.*) A horseman's pistol provided with a removable butt-piece, which

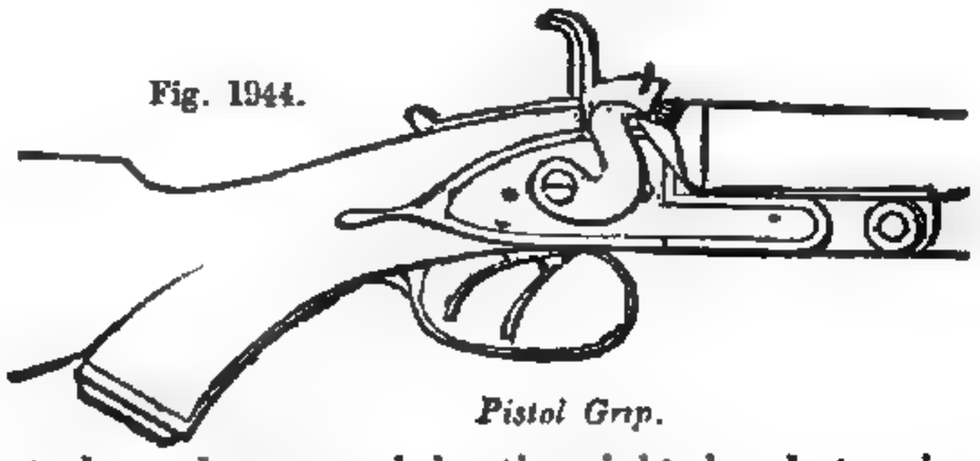
Fig. 3756

Pistol-Carbine.

may be secured to its stock by a spring-catch, or detached, so that the weapon may be fired either from the hand or the shoulder.

Pis'tol Grip. A protuberance shaped like the butt of a pistol beneath the *small* of a gun or rifle

Fig. 1944.



Pistol Grip.

stock, to be grasped by the right hand, to give steadiness to the grip in firing.

Pis'tol Ri'fling Ma-chine'. A standard machine cuts 5 grooves of an invariable pitch, in barrels 3.5″ to 5″ long, with or without feed for depth of grooves. See RIFLE, p. 1939, "*Mech. Dict.*"

The twist may vary from 1 turn in 72″ to 1 turn in 12″. — *Pratt & Whitney.*

Piv'ot-gun. A gun mounted on a carriage which may be revolved so as to sweep all points of the compass. Usually employed on shipboard, but sometimes in fortifications.

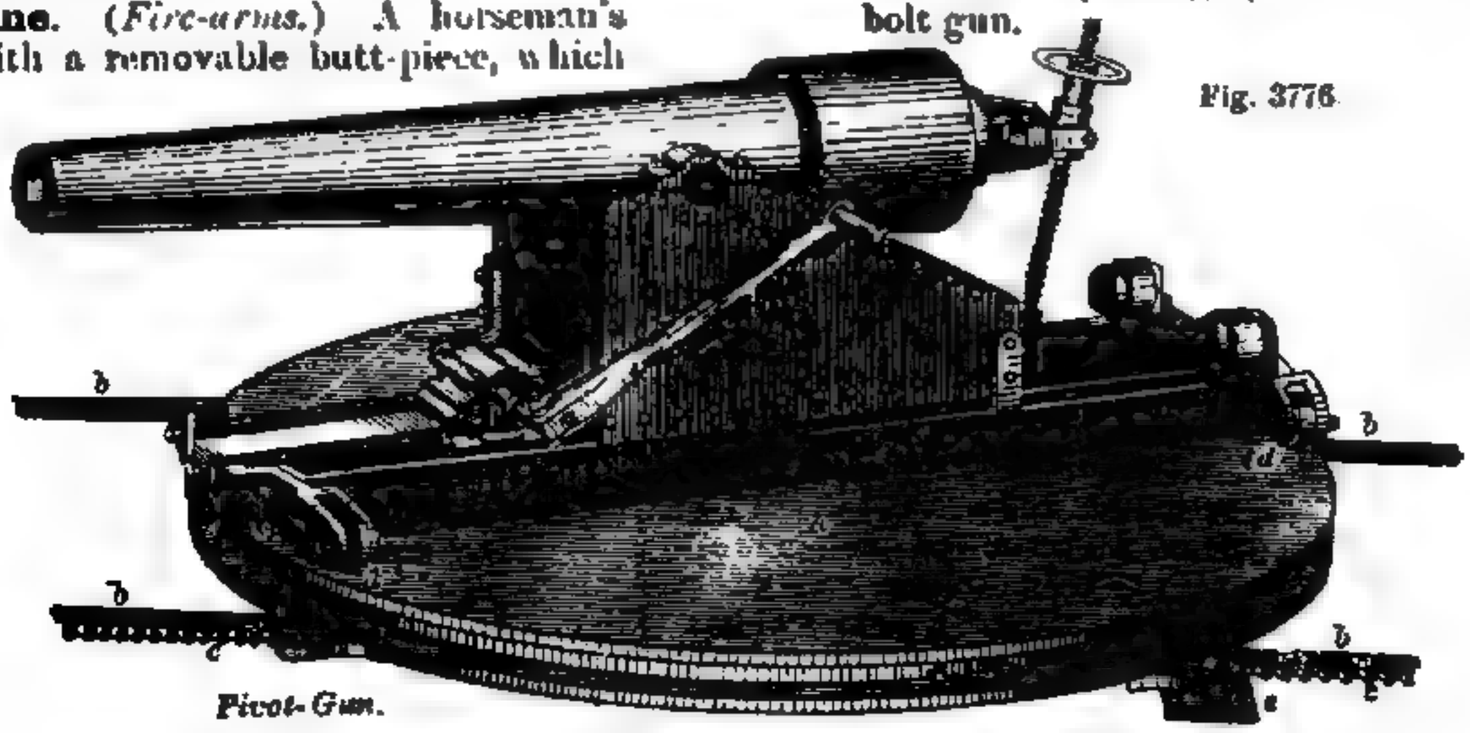
Fig. 3776 shows a Parrott gun mounted on a pivot-carriage adapted to be shifted from side to side of a vessel, so that one battery may answer for both broadsides. The carriage is in use on the thirty gunboats built for the Spanish government in New York, about 1870, and has since been adapted for other vessels. It was invented by Ericsson.

The platform *a* runs on tracks *b b* across the deck of the vessel, and may be propelled by a cog-wheel gearing in the rack *c* on one of the tracks The carriage proper is pivoted in the center of the platform, and rests on wheels *d d*. When in firing position the platform is fastened to the deck by pins, one of which is shown at *e*.

Plain Sight. (*Fire-arms.*) **A hind sight consisting of a simple notch in a raised plate or protuberance.**

Plun'ger. (*Fire arm.*) ***a*. A pin struck by the hammer and exploding the priming by force of the communicated blow. *b*. In other cases the plunger has the exploding point on its own end, as in the bolt gun.**

Fig. 3776



Pivot-Gun.

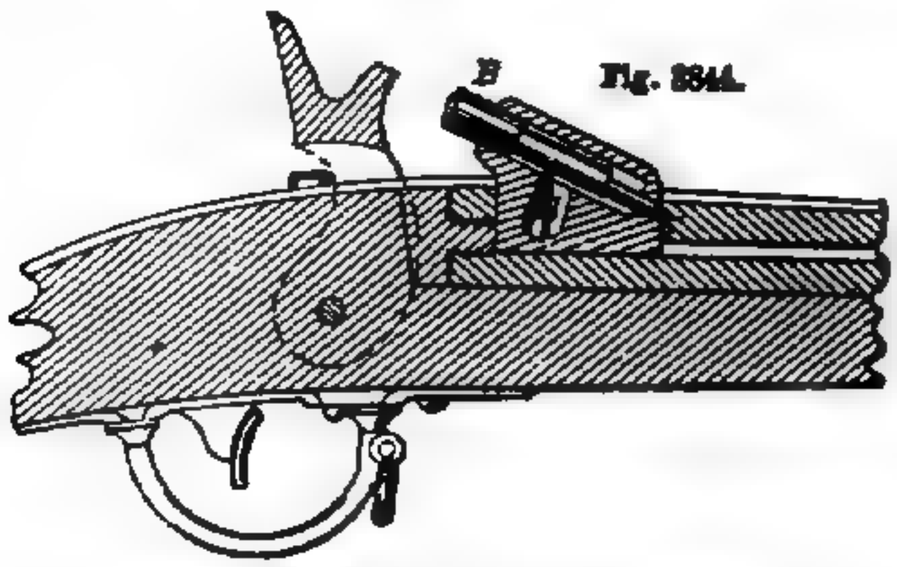


Fig. 2044.

Plunger or Firing-Pin.

The plunger *B* has a retaining spring *S* in the hinged block of the breech-loader. The spring is contained in a hole extending from the under side of the breech-block to the aperture in which the plunger works.

Point-blank. (*Gunnery.*) *a.* A shot discharged in a horizontal direction.

b. A gun horizontally leveled.

Point-blank range is the extent of apparent right-line of a ball horizontally discharged.

Port-fire. A paper tube filled with a composition of niter, sulphur, and mealed gunpowder; formerly used to fire guns. Now superseded by the friction-primer and gun-lock.

The *common port-fire* is sixteen inches long, and is packed with a composition which burns at the rate of about one inch per minute.

The *slow port-fire* consists of paper impregnated with saltpeter and rolled into a solid cylinder about sixteen inches long. It will burn three or four hours.

Port-fires may be made by boiling square rods of poplar or other light porous wood in a solution composed of one quart of water to one pound of nitrate of lead for six hours. These are then dried and afterward boiled in spirits of turpentine. One yard will burn three hours.

Port-fire Clip'per. A nippers for cutting off the ends of port-fires.

Pou'dre Bru'tale. Coarse, or *cube powder.* Slow burning powder in blocks of determinate size, consisting, in some cases, of cubes 1.5″ thick.

See PEBBLE POWDER; PELLET POWDER, *supra.*

Pow'der-chest. (*Nautical.*) A form of grenade consisting of a box charged with powder, old nails, etc., to be hurled at boarders.

Pow'der Dust'ing Ma-chine'. Gunpowder, whether pebble or granulated, is required to be clean, and the dusting operation intervenes between the pebbling or granulating and the glazing.

Dusting is performed in revolving cylindrical reels, with clothing of canvas or wire cloth of a fineness to suit the grade of powder. A reel 8′ long and 30″ diameter will have 40 revolutions per minute.

In Russia, the powder is dusted in bags. Fig. 26, accompanying Appendix L, "*Ordnance Report*," 1877.

See also "*Ordnance Report*," 1879, Appendix L, Plate IV., Fig. 9, and description on pp. 106, 107.

Pow'der-flask. A pouch or metallic case for holding gunpowder, and having a charging nozzle at the end.

Pow'der-horn. A horn fitted to hold powder and used as a flask.

Pow'der-hose. (*Blasting.*) A tube of strong linen, about an inch in diameter, filled with powder, and used in firing military mines.

Pow'der-ing-mill. See GRINDING-MILL; SNUFF-MILL; ORE, etc. See list under MILL.

Pow'der Pa'per. A substitute for gunpowder, invented in England.

Paper impregnated with a mixture of potassic chlorate, nitrate, prussiate, and chromate, powdered wood charcoal, and a little starch. It leaves no greasy residue on the gun, produces less smoke and less recoil, and is less impaired by humidity, and it is 5-16 stronger than gunpowder.

Pow'der Press'ing Ma-chine'. A machine in which the powder meal from the breaking-down machine is made into cakes. It is a hydraulic press, the box of which is 30″ × 14″, lined with oaken boards.

Pow'der Test'ing. In Britain, the chronograph is used to determine the velocity of the flight of the projectile, a given quantity of the powder under test being used in a service gun with a given ball.

In France, the test is in firing to extremity a cast-iron gun of a given model, made of a particular iron, and treated in a given manner, with charges of a fixed weight of the powder to be tested. A new gun of exactly similar character is used for each powder.

Press-cake. (*Gunpowder.*) **Incorporated or mill cake ready to undergo granulation.**

Pri'mer. 1. (*Ordnance.*) *a.* A small, supplementary tube used with some descriptions of heavy, breech-loading ordnance. It is placed in the horizontal part of the vent before the vent-piece is placed in the gun, and communicates the flame from the ordinary tube to the cartridge.

b. A wafer, cap, or tube containing a compound which may be exploded by percussion or by friction; used for igniting the charge of powder in a cannon. Those generally used in the navy are made from quills which are nearly filled with fine-grained gunpowder, the upper part of the quill being split and turned over for containing a capsule of fulminate which is exploded by a sudden blow of the lock-hammer. Friction-primers (which see) are exclusively employed in the land service.

2. (*Blasting.*) *Tape primers* are used for firing charges at a distance. They are formed of long flexible strips of paper or fabric containing fulminate or other quick-burning compound, and are covered with a water-proof composition.

A detonating primer used in blasting with gun-cotton consists of a frusto-conical tube having its lower end filled with a detonating composition, above which is a layer of gun-cotton; the upper part of the tube is empty, and is covered with a paper cap; an ordinary fuse is inserted into this cavity and fired in the usual manner.

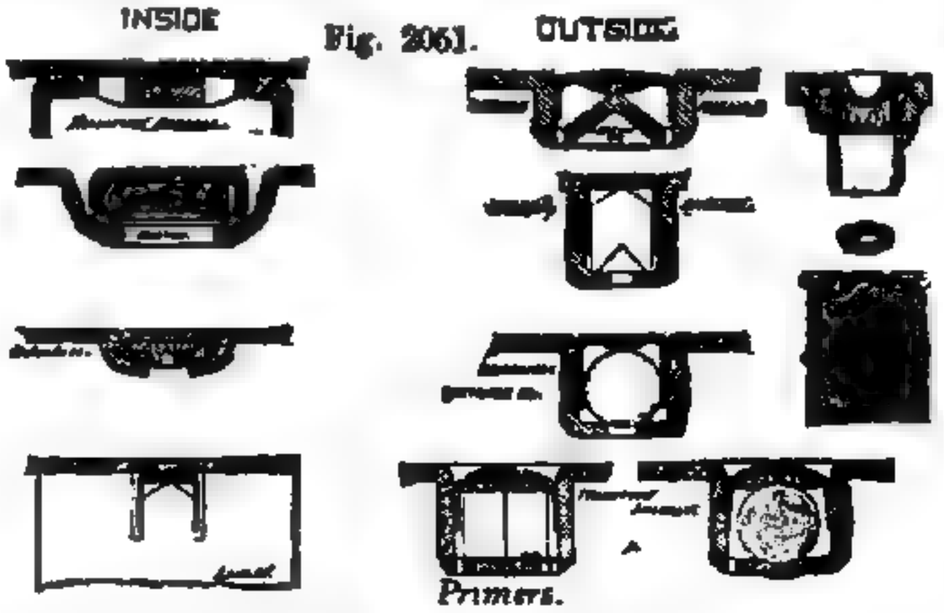
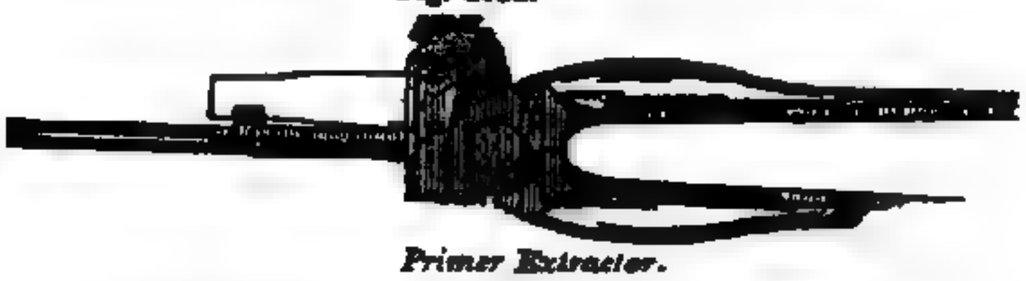


Fig. 2061.

Primers.

Fig. 2061 shows a variety; some adapted to the inside, and some to the outside of the head of the cartridge.

Fig. 2052.



Primer Extractor.

Pri'mer Ex-tract'or. A tool used to withdraw the spent primer capsule, in reloading metallic shells. See RELOADING TOOLS.

Prim'ing.

2. (*Fire-arms and Ordnance.*) The combustible which communicates fire to the charge.

3. (*Blasting.*) A train leading to a bursting-charge.

Prim'ing-horn. (*Blasting.*) The powder-horn of the miner or quarryman.

Prim'ing-pow'der. 1. Detonating powder.

2. The train of powder connecting a fuse with a charge.

Prim'ing-tube. (*Ordnance.*) A tube to contain an inflammable composition, which occupies the vent of a gun whose charge is fired when the composition is ignited.

There are several kinds of priming-tubes, fired by *port-fire*, *lock*, or friction.

The tube is made of *quill*, *paper*, or *metal*, and is charged with mealed powder damped with methylated spirit, or by a detonating composition, such as chlorate of potash and antimony.

The tube is slightly smaller than the gun-vent, in the relative proportions of $\frac{1}{16}$ and $\frac{1}{8}$ of an inch, and a hollow is made down the middle of the composition, so that the fire may involve the whole length instantaneously.

The simplest form is that in which the tube is merely a holder for the priming, which is touched off by a port-fire. This is the *quill*, Dutch, or *common metal tube*.

Another variety has a cross-head or snipe to contain a detonating composition which is exploded by a hammer. This is the *cross-headed* or *detonating tube*.

A third variety is operated by friction, a roughened bar occupying the hollow in the composition, and exploding by friction the detonating composition in the head of the tube. The rough bar is jerked out by a lanyard. See FRICTION-PRIMER.

Pri'ming Ma-chine'. A machine to put the fulminate in the cap, which is to be attached to the cartridge shell.

One which places the fulminate in percussion caps.

Prim'ing-wire. (*Ordnance.*) A pointed wire to prick a cartridge when it is *home* and clear the way for the priming or loose powder. A flat-headed wire to clear the vent of any ignited particles. Fig. 3945.

Pro-jec'tile. A missile, or package containing a number of missiles, projected from a gun by the expansive force of air, gas, or steam; commonly the gases generated by the ignition of gunpowder.

See also PRIMER, SABOT, FUZE, WADDING, PACKING, PERCUSSION-CAP, CHARGE, and the other accessories.

The number of projectiles used in the Crimean war, as compiled from official data, is as follows: French, 20,460,333; English, 15,000,000: Piedmontese, 50,000: Turks, 50,000: Naval forces (Allied), 35,000; Russian, 45,000,000. Total, 80,595,333.

Killed and wounded by these projectiles: French, 50,836; English, 21,088; Piedmontese, 183: Turks, 1,000; Naval forces (Allied), 2,000: Russian, 100,000 Total, 175,057.

One projectile in 512 did execution, upon the supposition that no two projectiles struck one person.

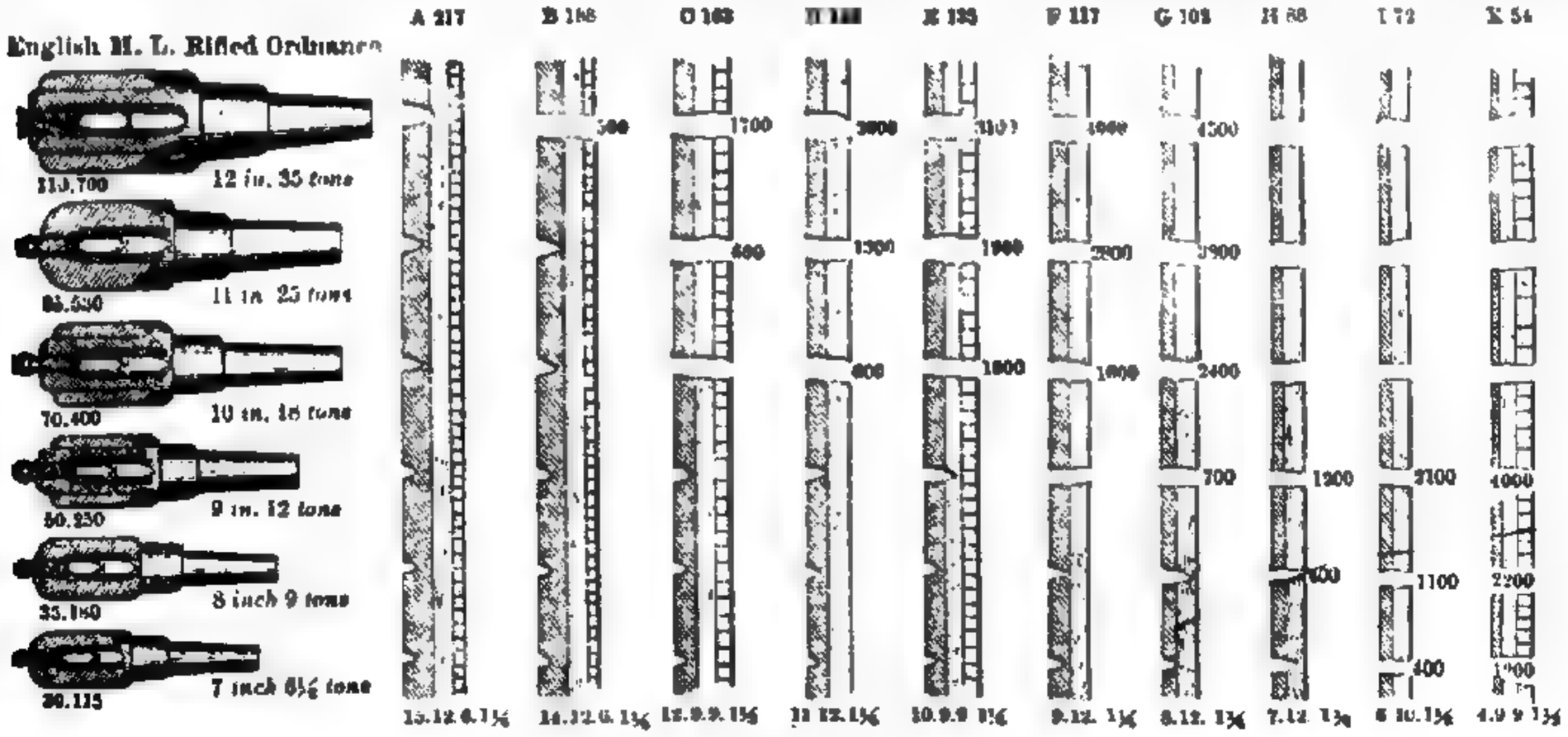
Fig. 3970 is a diagram showing the perforating and penetrating power, at various distances, of Palliser projectiles, fired from the service rifled muzzle-loading guns, with battering charges of pebble powder. Each target, representing in resisting power a certain class of vessel, is supposed to be at the normal distance of 200 yards from the gun, except where the range at which the projectile would perforate such a target is expressly stated. Thus the diagram shows that a target consisting of a 14-inch plate, backed by 18 inches of timber, and a 1¼-inch iron skin, would be perforated at 500 yards by the 12-inch 35-ton gun: whereas the Palliser projectiles fired from the 11-inch 25-ton gun would only penetrate to a depth of 16 inches into the same target at 200 yards.

The weights of guns and force of impact are expressed in English tons of 2,240 pounds. The figures under each gun are respectively: —

Weight of powder. Diameter of bore.
Weight of ball. Weight of gun.

The figures opposite the holes through the targets are the distances in yards up to which the shot made a clean breach. The power of resistance of each target is given immediately

Fig. 3970.



Penetration of Projectiles

over it; thus A 217 means that it would require an energy of 217 foot tons per inch of the shot's circumference to perforate class A. All projectiles are assumed to strike perpendicularly to the face of the target

The figures beneath the armor are the thicknesses of the plating, backing, and skin.

Pro-longe'. (*Ordnance.*) A rope used to drag a gun-carriage without the limber in maneuvering when it is required to move in a narrow track, or in retiring firing along a street or through a defile. It has a hook at one end and a ring at the other.

Proof —

4. (*Ordnance.*) The tests are by hydraulic pressure and by firing charges.

The proof charge is much heavier than the service charge, and is repeated, close examination being made for flaws and crevices.

The proof by water is under a heavy pressure; the bore being wiped dry, the surface is examined by a mirror to detect the exudation of moisture from crevices or honeycomb.

5. (*Small-arms.*) The barrels are loaded with a heavy charge, laid on a massive table in the proving-room, and fired by means of a train of powder, the balls being received in a sand-bank. This is repeated.

The proving of gun-barrels at Ilion is thus performed: forty barrels are loaded at a time, with 280 grains of powder and 500 grains of lead in each, and arranged in a small room, to be all discharged at once: they are placed in position, wedged, and held down by a heavy beam; a train of powder is then laid to all the touch-holes, the workmen leave the room, and all is ready; the double doors having been closed, the tester strikes with a hammer a small rod of iron protruding through the wooden partition; the rod is driven into a percussion-cap at the end of the train of powder, and the explosion of the charges in all the rifles immediately occurs. The value of this test is very great, the ordinary charge being 70 grains of lead. The barrels are afterward tested with 150 grains of powder, to see if they have been strained by the first test.

Swords are proved by bending them and seeing if they resume their original shape, and by striking them flatwise over a curved block of hard wood.

6. (*Gunpowder.*) *a. Ordinary proof of powder;* one ounce with a 24-pound ball. The mean range of new, proved at any one time, must not be less than 250 yards; but none ranging below 225 yards is received.

Powder in magazines that does not range over 180 yards is held to be unserviceable.

Good powder averages from 280 to 300 yards; *small grain*, from 300 to 320 yards.

b. A proof of blasting-powder is, that two ounces being fired in an 8-inch mortar, elevated at an angle of 45°, shall throw a ball of 68 pounds to a distance of 240 feet.

Another test is, that two ounces of powder in the eprouvette gun (weight, 86½ pounds; bore, 27.6 inches long and 1⅜ inches diameter) shall give a recoil of 20°.

Proof-house. A house fitted up for *proving* barrels of fire-arms. They are extra heavily charged, laid on a bench, primed, and fired by a train of powder into a bank of sand. The average loss in England is four per cent on 600,000 barrels annually.

A second proving takes place when the piece is ready for assembling.

Proof-plug. A plug screwed temporarily into the breech of a gun-barrel to be proved.

Pul'ver-iz'ing. (*Gunpowder-manufacture.*) A mill in which the ingredients are separately reduced to an impalpable powder before being transferred to the incorporating-mill.

In the United States this is generally effected by the rolling-barrel.

Py-roph'o-rus. Mechanically considered, an apparatus for kindling fire.

Chemically considered, a substance which takes fire when exposed to the air.

Homberg's pyrophorus depends upon the heat spontaneously developed by the association of alum, sugar, and flour.

Brande recommends a mixture of equal parts of alum and brown sugar stirred over a fire in an iron ladle till quite dry. It is then put into an earthen or coated glass bottle, and heated red-hot so long as a flame appears at the mouth. It is then removed, carefully stopped, and allowed to cool. The black powder which it contains becomes glowing hot when exposed to air. The experiment succeeds best in a damp state of the air, and may be accelerated by breathing upon the powder.

Two other recipes are given by Brande:—

Mix 8 parts of lampblack, 8 parts of carbonate of potassa, 4 parts of dried alum. Calcine as before.

Or, 27 parts of sulphate of potassa, 15 parts of calcined lampblack. Heat to redness in a crucible, and keep in a stoppered bottle.

Or, heat tartrate of lead red-hot in a glass tube and seal hermetically. Break the tube and shake out the powder, which inflames spontaneously by contact with the air.

See Cooley's "Cyclopædia," page 1084.

A pyrophorus for cigars is described as follows: Neutral sulphate of iron is treated with diluted nitric acid and precipitated; the resulting oxide is reduced by heat in a tube through which a current of hydrogen is passed. This is combined with a sulphide of aluminium and potassium and a small amount of carbon. A portion of this is placed on the end of a cigar, the breath is inhaled, and by the affinity of certain particles of the composition for oxygen the iron is heated and the cigar lighted.

Pyr'o-tech'nics. Preparations of inflammable material are used in making cascades of fire or explosions for signals or as expressions of rejoicing.

Fire-works are of Oriental origin. The Chinese and Japanese still excel in their production. The "Yokohama Herald" describes the effects produced at an exhibition of Japanese day-light fire-works These consisted principally of bombs which, exploding high in the air, discharged variously colored jets of smoke, and sometimes large parachutes which assumed the figures of fishes, snakes, or birds, which hovered kite-like and motionless in the air for an incredibly long time. Occasionally they took the shape of cottages, temples, human beings, trees, and flowers, and various other forms. The smoke figures were, however, the most amusing. One of those most frequently attempted was a cuttle-fish, with a body of thick black smoke, and arms of lighter hues. Though the smoke was soon dissipated by the wind, the resemblance for a few moments was very striking.

Our artificers do not possess the secret of making fire-works such as these, their efforts being confined to the production of variously colored fires for exhibition at night. The basis for nearly all pyrotechnic compositions consists of niter, sulphur, and charcoal in varied proportions pulverized and mixed with some material which imparts color to the flame. The nitrate of strontia produces a red light; nitrate of soda, yellow; sulphate of copper, blue; nitrate of baryta, green. Steel, iron, copper, and zinc filings are used for producing brilliant sparks of various colors.

Besides these, numerous other substances are used for producing different tints, most of which may be found in works on pyrotechny, though many artists in this line claim to have secret compounds or processes for producing peculiarly brilliant flames. The compositions are formed into small pieces called stars, for insertion in rockets and bombs, or are driven into paper cases which are attached to light frameworks of wood or bamboo for stationary fire-works.

Q

Quick-match. Cotton-wick is b
peter and rain-water for 1 hour; alcoh
the mixture while warm, and it is sim
minutes. Mealed powder is then ad
whole left for 24 hours. The cotton-w
on a reel, and mealed powder sifted o
then dried.

oiled in salt-
ol is added to
mmered for 15
lded, and the
wick is wound
over it. It is

R

Ram'mer. 1. (*Fire-arms.*) *a.* The rod by which the charge is forced home. See RAMROD.

b. A staff having a cylindrical or conoidal head attached, used in cannon for the same purpose. The rammer-head is made of beech, maple, or other hard wood not easily split, and is bored for about two thirds of its length to receive a tenon on the staff. For rifled guns or for hollow projectiles, its face is countersunk.

Rammers for large guns are technically termed *rammers* and *staves*. For field artillery, a *sponge* is attached to the other end of the staff, and the combined implement is called a *sponge and rammer*.

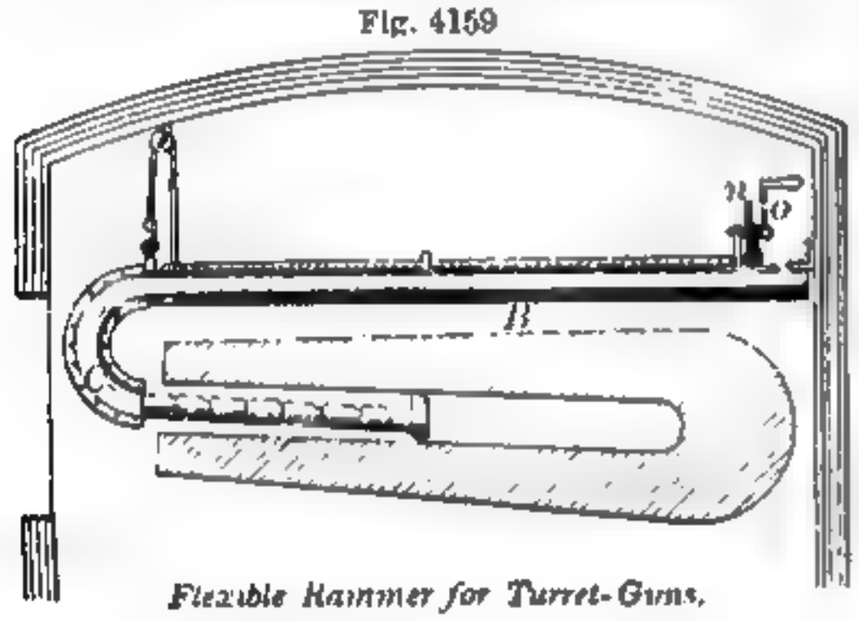
The sponge is made of coarse, well-twisted woolen yarn, woven into a warp of strong hemp or flax thread, after the manner of Brussels carpet.

They are woven in threads with selvages between them, which, being cut, the sponges are sewed to fit formers of the same diameter as the sponge-heads.

Hair sponges, frequently called brush-wipers, are sometimes employed, and are very useful, for cleaning the grooves of rifled guns.

Fig. 4159 is a flexible rammer for turret-guns. It is attached to the monitor turret by a hinge, so as to be lowered into serviceable position when required. It is composed of a tube *B* surrounding a series of jointed plates *C*, which can be flexed in one direction, and are caused to protrude from the tube and follow the bore of the gun by means of a screw operated by a hand crank and gear *n o*, or other suitable mechanism.

Fig. 4159



Flexible Rammer for Turret-Guns.

Ram'rod. A rod of wood or metal, used for forcing the charge to the bottom of a gun-barrel, and also with a *wiper* or *ball-screw* attached, for cleansing the interior of the barrel and for withdrawing a charge. It is held to the gun by thimbles or by grooves in the band and a corresponding groove in the stock.

Wooden ones are now only used for sporting arms. The iron ramrod did not supersede the wooden one until 1742. It was introduced into the Prussian army by Prince Leopold, of Anhalt-Dessau.

The United States service ramrod, used prior to the introduction of breechloaders, is made of steel. Its parts are:—

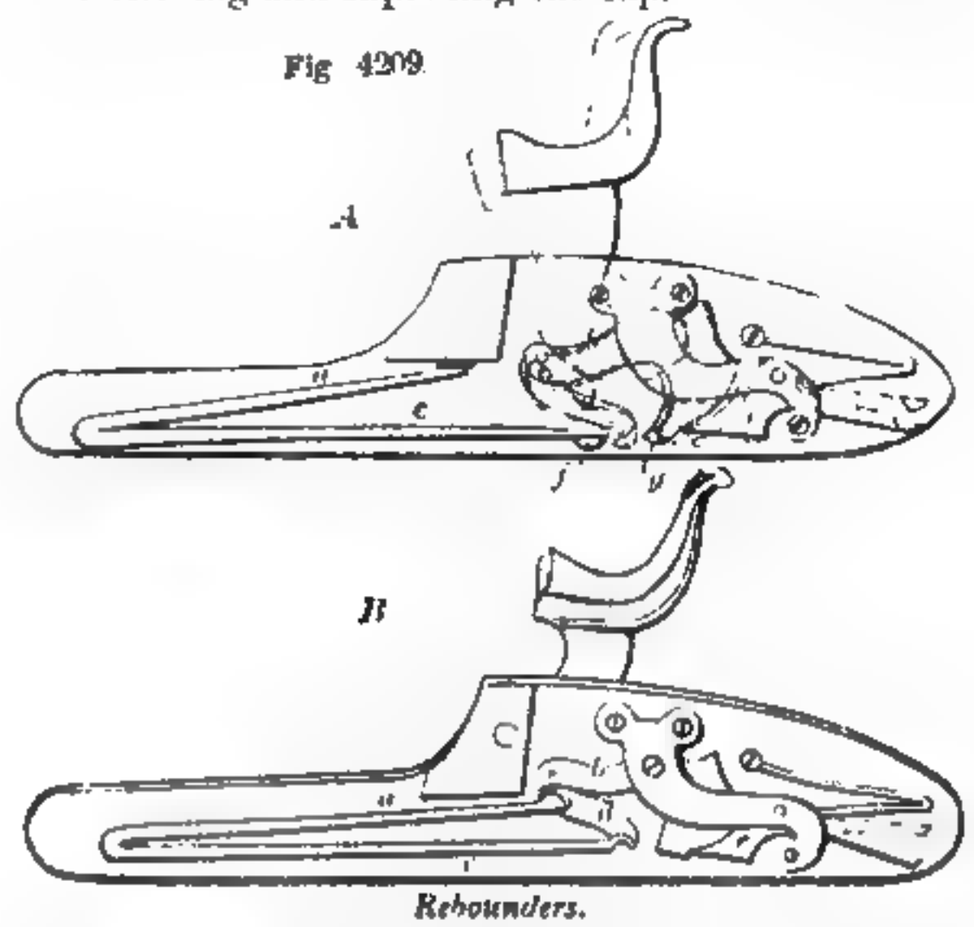
The stem.	The thread.
The head.	The cap.
The cup.	

It generally is made with a swell, to keep it in place; but in some patterns a spring in the stock serves this purpose, and the swell is dispensed with.

Ramrods, in the large gun-factories, are made by machinery In the case of wooden ones, the blanks are driven through tubular cutters, which bring them to a cylindrical form. The iron ones are cut from a round rod. For polishing, they are placed upright in a frame which holds ten at a time, and are subjected to the action of hard-wood rubbers supplied with oil and polishing-powder. The grooved ends of the rubbers are pressed against the ramrods by springs, and the rubbers receive a rapid motion while the ramrods are slowly revolved.

Re-bound'er. (*Fire-arms.*) A device in a gun-lock for throwing the hammer back from the nipple after striking and exploding the cap.

Fig. 4209



Rebounders.

This is usually effected, as at *B*, Fig. 4209, by lengthening the shorter branch *a* of the main-spring so that the arm *b* of the tumbler shall strike it just previous to the impact of the hammer on the cap, caused by the action of the long branch *c* of the main-spring transmitted through the swivel *d*; the effort made by the branch *c* in restoring itself, after the momentary compression, throws back the tumbler sufficiently far to permit the sear *e* to enter the half-cock notch.

In Dane's patent (*A*), used in the Parker gun (see SHOT-GUN), the long branch of the main-spring is arrested by a stop *f* at about the position of half-cock, the tumbler being carried forward by its momentum until it strikes the cap,

when the pressure of the sear on the cam-shaped extension *g* throws the tumbler back until the nose of the sear enters the half-cock notch, or sufficiently far to lift the hammer clear of the nipple.

Re-coil' Check. 1. An apparatus to absorb the recoil of a cannon, otherwise known as a hydraulic buffer, which see.

See 10″ gun-carriage, with hydraulic recoil check. Plate VI., attached to Appendix H, "*Ordnance Report*," 1876.

2. A spring cushion attached to the butt-end of a gun-stock to take the force of the recoil.—*Miller*, No. 169,465.

Re-coil' Dy'na-mom'e-ter. An instrument to measure the recoil of small arms.

Lieut. Metcalfe's device is to measure the recoil by substituting for springs a material of uniform resistance, such as copper or lead, and measuring the recoil by means of a cut made in the material by a Rodman knife interposed between the metal and the butt of the gun.

Re-flecting Sight. (*Fire-arm.*) The sight has a re-

flecting surface placed at such an angle as to reflect to the eye light from one direction only.

Re'in-force'. (*Cartridge.*) A lining or plate to strengthen the head of a cartridge, sometimes also acting as an anvil or a gas check. See CUP ANVIL; DISK ANVIL; GAS CHECK.

Re-load'ing Tools. For reloading spent capsules of breech-loading fire-arms. A complete set for rifle cartridges consists of primer extractor, charger, loader, and reprimer, which see.

Fig. 2115 shows a single tool with the functions of decapper, recapper, and rammer comprised within a weight of

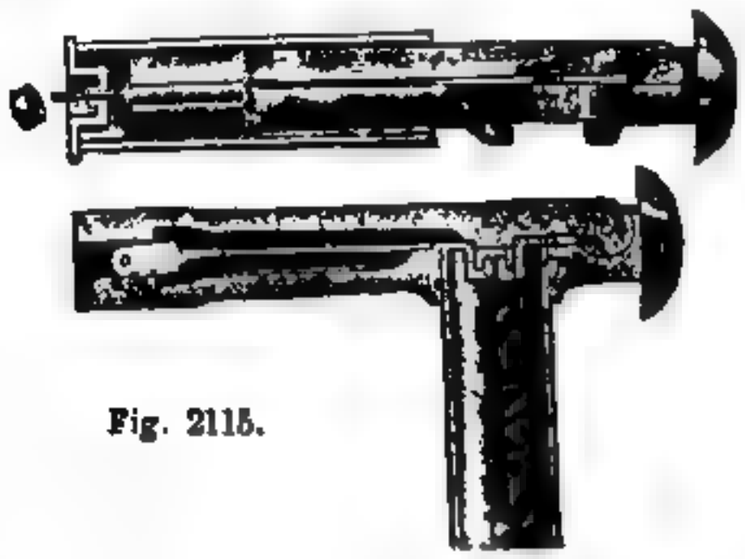


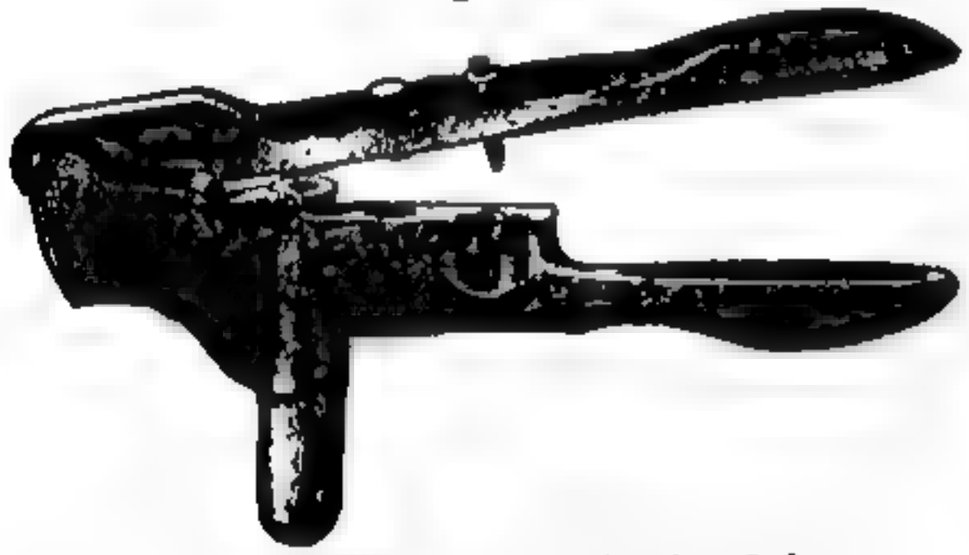
Fig. 2115.

Reloading Tools for Breech-loading Shot-guns.

5 oz. On the side is also a device for extracting expanded shells. — *Providence Tool Co.*

Fig. 2116 is a tool which removes the exploded primer, in-

Fig. 2116.



Reloading Tool for Breech-loading Rifles.

serts the new primer and fastens the ball in its shell, at the same time swaging the cartridge to form.

Re-peat'er. 1. (*Horology.*) A watch made to strike the time when the stem is pushed in. Some strike the hour and quarters; others, the hour, quarter, and odd minutes. They are expensive and delicate, owing to the assemblage of so many parts within so limited a space.

Some *repeaters*, in addition to their announcement of the hour when called on, will strike the hours and quarters as they recur. A *striking* watch merely has not the faculty for *repeating* when called on so to do.

Alarms are also attached to watches. The machinery is somewhat similar to that of the alarm-clock.

James I., in person, heard arguments on interfering applications for patents for repeating-watches (Barlow *vs.* Quare), and decided in favor of Quare (1676). Priority of invention belonged, however, to Barlow, who employed two pins to strike the hours and quarters, while Quare afterward effected this with one only.

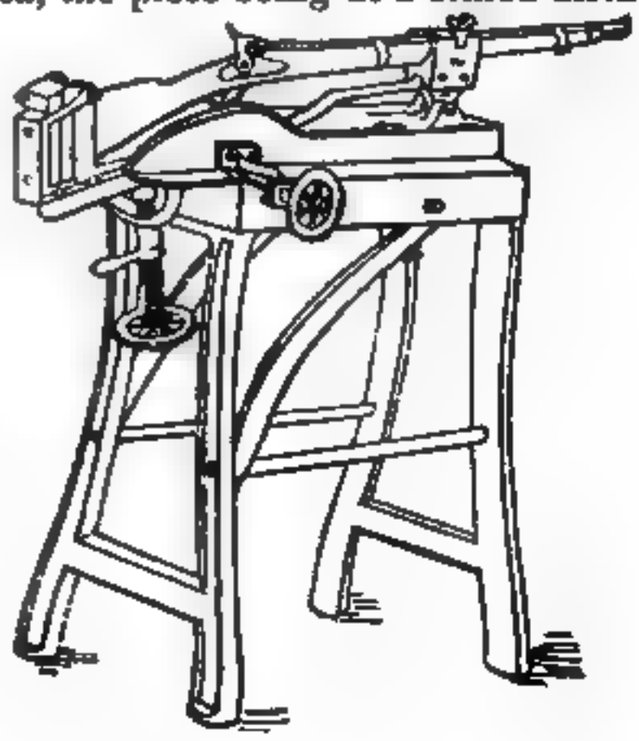
The smallest repeating-watch ever known was made by Arnold for George III.; to whom it was presented on his birthday, June 4, 1764. Although less than six tenths of an inch in diameter, it repeated the hours, quarters, and half-quarters, and contained the first ruby cylinder ever made. Its weight was that of an English silver sixpence. Arnold made it himself, and also the tools employed in its construction. The king presented Arnold with 500 guineas ($2,500) for this curious watch, and the Emperor of Russia afterward offered the maker 1,000 guineas for a duplicate of it, which Arnold declined.

2. (*Fire-arms.*) An arm which may be caused to fire several successive shots without reloading. In Colt's and other revolvers, the charges are placed in chambers in a rotating cylinder, and brought successively in line with the barrel; while in the Spencer, Winchester, and Henry rifles, and others of that class, a number of the cartridges are inserted in a chamber at the butt or beneath the barrel, and fed and discharged singly by mechanism connected with the lock devices; metallic cartridges only are employed, the case being automatically ejected after each discharge. See FIRE-ARMS; REVOLVER.

Re-peat'ing Rifle. One which fires charges consecutively from a magazine.

The German repeating rifle, made at the School of Musketry at Spandau, is a Mauser rifle with magazine attachment. The magazine is made from steel plate, and contains 11 cartridges. It can be readily put off and on the rifle, and is worked on it solely by opening and shutting the chamber in such a way that at every opening movement a cartridge falls through the groove into the rifle, and by every shutting movement the next cartridge is made ready for use. This apparatus can be attached to all breech-loaders with a cylinder breech. By it 12 rounds are fired in 24 seconds; the magazine can be refilled in 15 seconds. When the magazine is removed the piece forms an ordinary one-barrelled gun

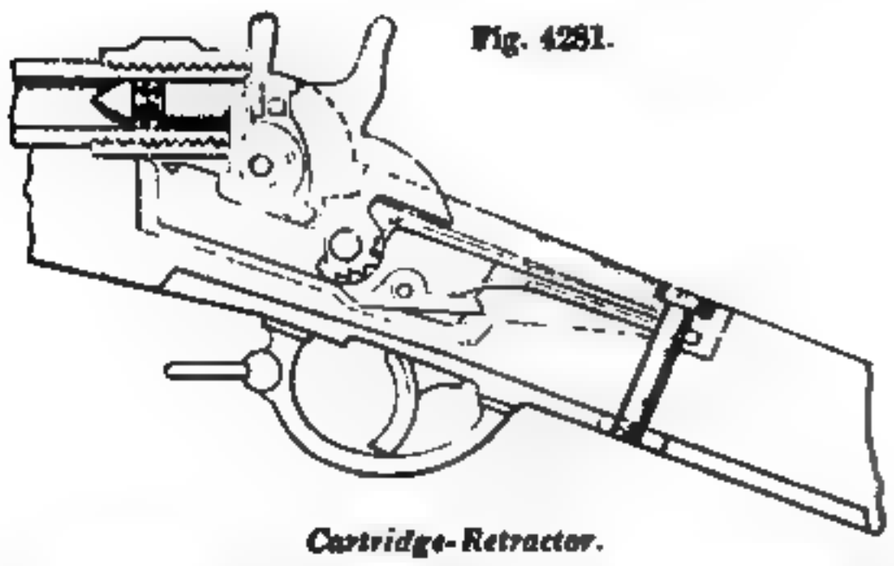
Rest. 1. A support for a gun in test-firing. See Fig. 2123. The design is to ascertain the actual accuracy of the piece, in ball-firing; or, in the case of shot-guns, the number of pellets of a given size, which strike a target of a given area, the piece being at a stated distance.



Fixed Rest for firing small arms.

2. (*Fire-arms.*) A device by which the metallic

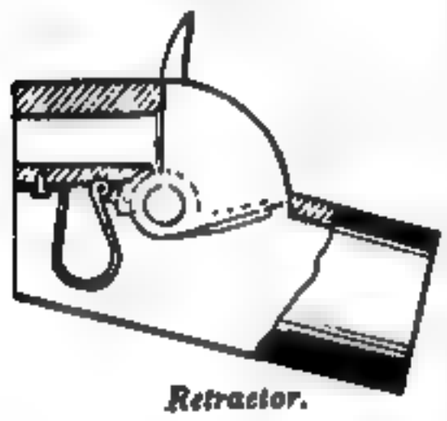
Fig. 4281.



Cartridge-Retractor.

cartridge-cases employed in breech-loading guns are withdrawn after firing. A lug or prong rests behind the flange of the cartridge and withdraws the spent shell when the breech is opened. In Fig. 4282, the positive movement of the notched extractor-plate loosens the shell from the bore, and after passing a certain point a spring comes into play, and gives a sudden impulse to the shell, which throws it clear of the fire-arm.

Fig. 4282.



Retractor.

Re-volv'er. 1. (*Weapon.*) A fire-arm having a revolving barrel or breech cylinder, so as to discharge several loads in quick succession without being reloaded. In some pistols the barrel has a plurality of bores, in which the charges are inserted and from which they are fired; more commonly, as in Colt's, the weapon has a cylinder at the base of the barrel, containing several chambers, generally six, in which the loads are placed, and all are fired through the single tube which constitutes the barrel; in all the rotation is caused by devices actuated by the lock mechanism.

The principle is not new, but it was first made a practical success by the late Colonel Samuel Colt.

Colt's revolving pistol is shown in section at *D*, and the cylinder and revolving mechanism detached at *E*. In general construction it closely resembles the rifle. The barrel *c* is of steel and rifled. It has a socket beneath for receiving the rammer *d* with its lever *d'* and fixtures, and a longitudinal socket and transverse slot to receive and secure the cylinder-pin *e*.

The cylinder *f* is of steel, and has five or six chambers, of the same size as the barrel, or a very little larger, bored through it nearly to the rear end, leaving a sufficient thickness of metal to insure against bursting. Behind and entering each chamber a cavity is made, at the base of which is a screw-threaded orifice, entering the cylinder, into which a cone is screwed.

In another hole bored axially through the cylinder, the pin on which it turns passes, one end entering a cavity in the base of the lock-frame, and the other a socket in the enlarged portion beneath the barrel, where it is secured by a key.

On the base of the cylinder *f* is a ratchet having as many teeth, five or six, as the chamber has barrels. The teeth are so arranged that when the hammer is at full cock, a chamber is directly in line with the barrel. On the surface of the cylinder are cut as many small slots as there are chambers. That which happens to be lowest at the time is entered by a bolt which is moved by the action of the lock, and is pressed into the slot by a spring, so that while in this position the cylinder is immovable.

The lock-frame is directly in rear of the cylinder, and contains the firing mechanism.

The rear and trigger are in one piece, as are also the hammer and tumbler *g*, upon which the main-spring acts directly. On the face of the tumbler is a pawl or *hand* *h*, which successively engages each of the teeth on the rear of the cylinder; and the tumbler has also a projecting pin which at the proper time engages the bolt that locks the cylinder, lifting it out of the slot and allowing the cylinder to rotate under the action of the hand. When the pin no longer acts upon the bolt, it is forced by the spring into the next notch which presents itself.

Fig. 4291.

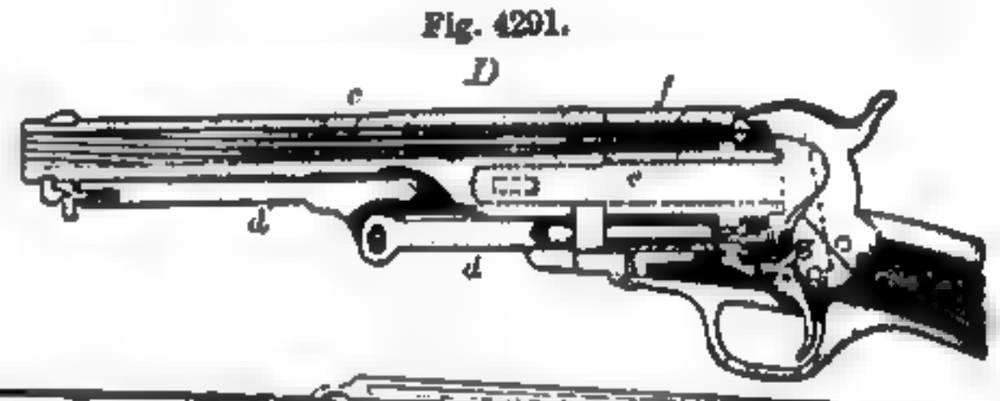
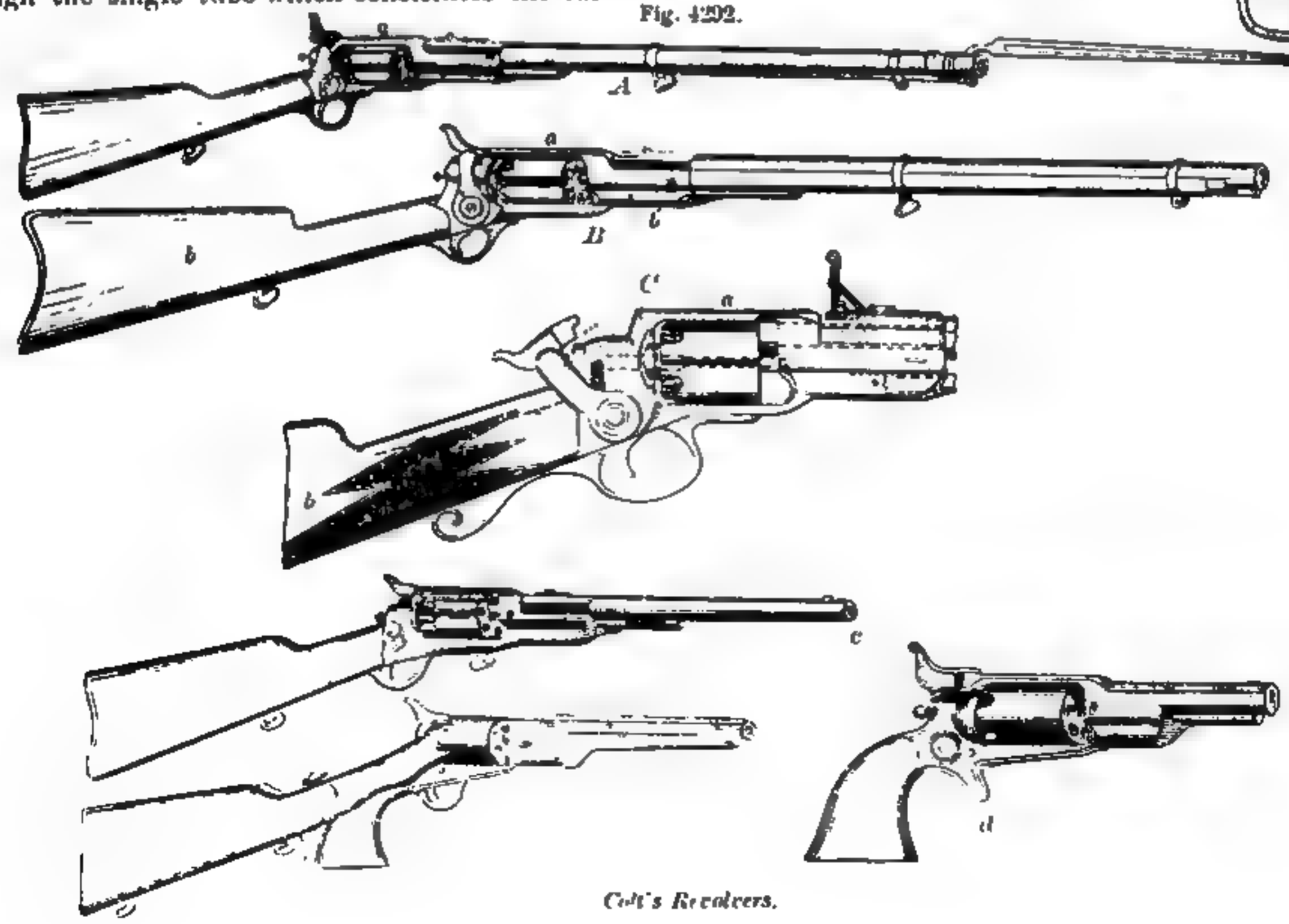


Fig. 4292.



Colt's Revolvers.

Colt's Revolver.

The operation is as follows: The chambers having been loaded by inserting a cartridge successively in each and forcing it home by the rammer and its lever, and capping each cone, the hammer, supposed to be resting on one of the cones, is drawn back; this causes the pin on the tumbler to disengage the bolt from the lowermost slot in the cylinder, and the hand engages a tooth and rotates the cylinder $\frac{1}{8}$ or $\frac{1}{6}$ of a revolution; on arriving at full cock the pin is disengaged from the bolt, which then falls into the next slot and locks the cylinder; the weapon may then be discharged by pulling the trigger.

In those pistols which are designed for firing metallic cartridges, the cartridge is inserted at the base of the cylinder, the case being afterward pushed out by a device analogous to the rammer just described.

Fig. 4292 shows a group of Colt's revolvers.

A, the revolver musket for infantry.

B, a revolving rifle for sporting.

C, a revolver-carbine.

d, a pistol.

e, a pistol mounted on a supplementary stock for shooting from the shoulder.

Colonel Colt obtained his first patent in 1835, but his weapon was not perfected until 1845. On visiting England, he undertook to investigate the origin of repeating fire-arms, and the result of his researches was that arms similar in principle to his own revolver had been invented four centuries before.

In the Tower of London he was shown a match-lock gun, dating back to the fifteenth century, and closely resembling, in the principle of its construction, the revolver of the present day. It has a revolving breech with four chambers, mounted on an axis fixed parallel to the barrel, and on that axis it may be turned round, to bring any one of the four loaded chambers in succession in a line with the barrel, to be discharged through it. There are notches in a flange at the fore end of the revolving breech to receive the end of a spring, which is fixed to the stock of the gun, for the purpose of locking the breech when a chamber is brought round into the proper position. The hammer is split at the end, so as to clasp a match, and to carry its ignited end down to the priming powder, when the trigger is pulled. Each chamber is provided with a priming-pan that is covered by a swing lid, and, before firing, the lid is pushed aside by the finger, to expose the priming powder to the action of the lighted match. In the lower armory was a specimen of a repeating fire-arm of a more recent date, though still very ancient, and presenting considerable improvement on the preceding one. It has six chambers in the rotating breech, and is furnished with a barytes lock and one priming-pan, to fire all the chambers. The priming-pan is fitted with a sliding cover, and a vertical wheel with a serrated edge projects into it, nearly in contact with the powder in the pan. To this wheel a rapid motion is given by means of a trigger-spring, acting upon a lever attached to the axis of the wheel, and the teeth of the wheel strike against the barytes, which is brought down, previously to firing, into contact with it, and the sparks thus emitted set fire to the powder in the priming-pan, and discharge the piece. In this instance, also, the breech is rotated by hand.

In Smith and Wesson's revolver (Fig. 4293), the

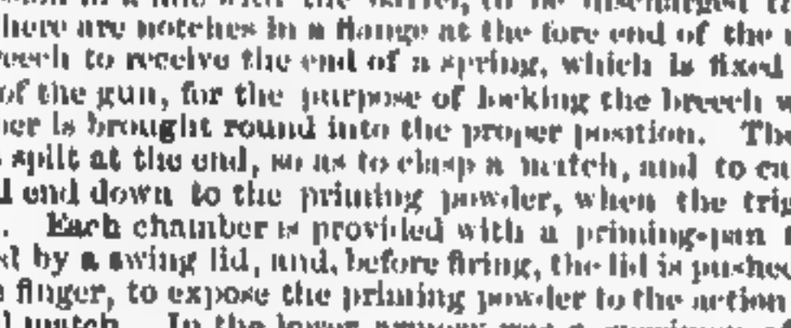
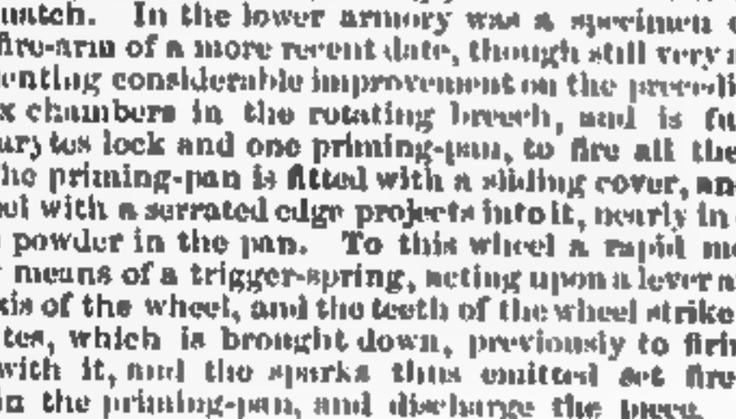


Fig. 4293.



Smith and Wesson's Revolver.

cylinder is rotated in the usual way by a click operated by the hammer in cocking and firing.

The cylinder is connected with the barrel, which is pivoted to the lower metallic part of the stock, so that by setting the hammer at half cock, raising a spring-catch *a*, and depressing the muzzle, the bottom of the cylinder is turned up to receive the metallic cartridges. When the muzzle end of the barrel is thrown upward, the spring-catch reengages in the back plate, and the pistol may be fired.

Fig. 4294 shows six revolvers which are interesting in the history of that fire-arm.

a is a matchlock of the fifteenth century, in the Museum of the Tower of London. It has a revolving breech with four chambers, which rotates on an arbor parallel to the barrel. The chamber is turned by hand.

b is an arquebuse, with six chambers, each of which carries its own pan for priming powder. A movable plate covers the powder-pans and exposes them serially to the match as a given chamber comes in line with the barrel. This is an Oriental piece, and was given to Mr. Forsyth by Lord William Bentwick, the governor-general of India.

c is an arquebuse, in the Tower of London, with six chambers in a revolving breech, and a flint lock. This has a sliding plate over the powder-pan. The turning of the breech is automatic.

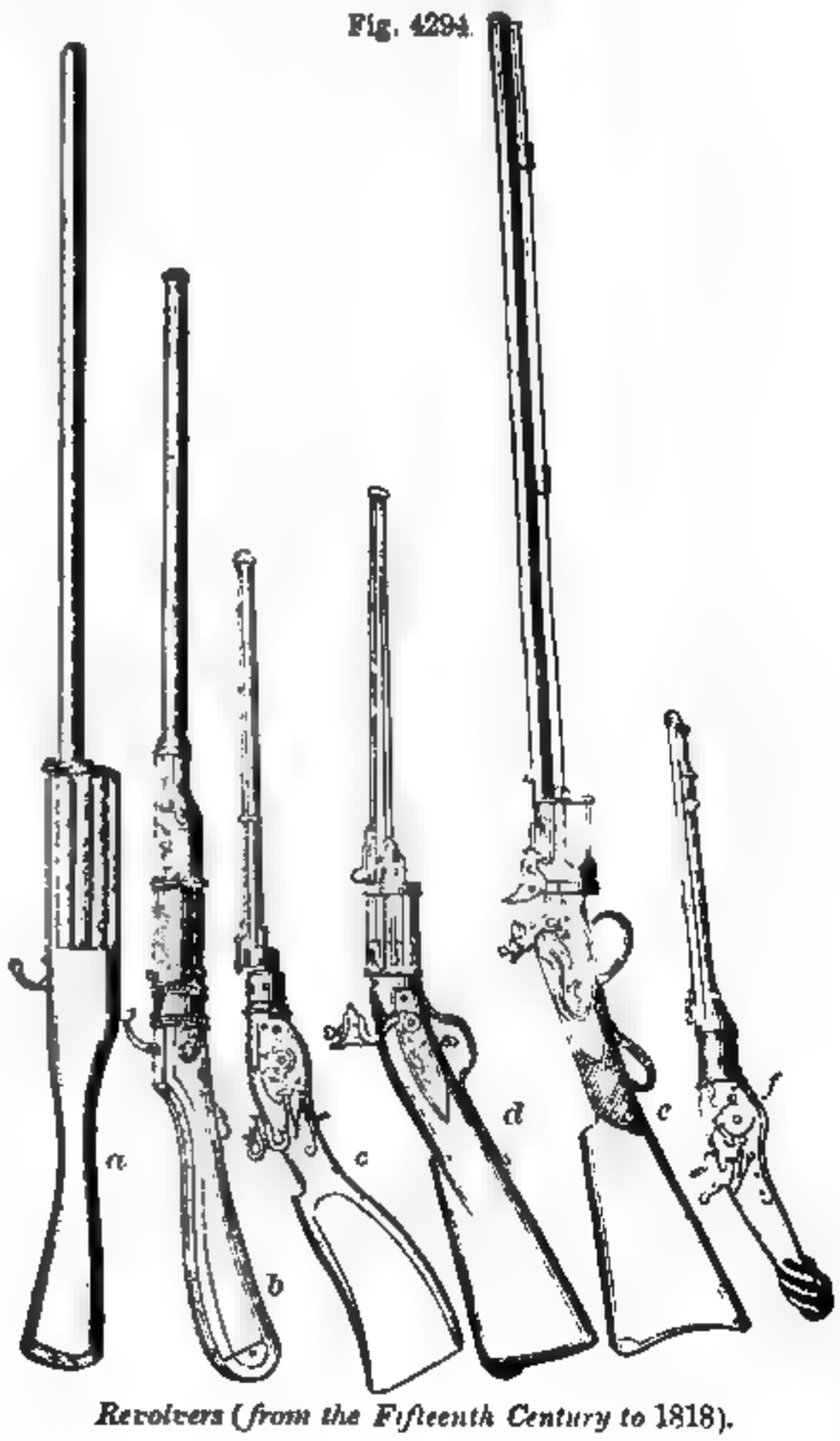
d is the arm of John Dafts, of London, and has six chambers.

e is Elisha Collier's arm, patented in the United States in 1818. The charge-cylinder has five chambers, and is turned by hand. The cylinder is held between two plates, of which the lower presses the cylinder toward the barrel, and the upper plate closes the chambers. The rod serving to charge the chambers is placed in the stock. The hammer carries a magazine of priming placed in the stock. This gun is No. 1291 of the collection in the Museum of "St. Thomas d'Aquin," in France, where also are several other ancient arms with revolving-chambered breeches.

f is a revolving-chamber flint-lock pistol at Woolwich.

They are thus described in Turgan's "Études sur l'Artillerie Moderne," Paris, 1867. The cylinders are all revolved by hand, and not by special mechanism. Three are with notches, and

Fig. 4294.



Revolvers (from the Fifteenth Century to 1818).

were made in the beginning of the seventeenth century. One (No. 1251) is a small flint-lock hunting arquebuse: the cylinder has eight chambers. The vent is closed by a sliding cover, a spring with a hook stops the cylinder at the time it is in line with the barrel.

1252 of the same collection) is an arquebuse with a match; the cylinder has five chambers, and turns upon an axis parallel with the barrel. It has a pan for each barrel.

1253 is a five-charge match arquebuse, having but one pan, of which you renew the priming at each shot.

1254 is a German musket of the middle of the seventeenth century. It has a wheel-lock. It has three chambers, and turns on an axis parallel with the barrel.

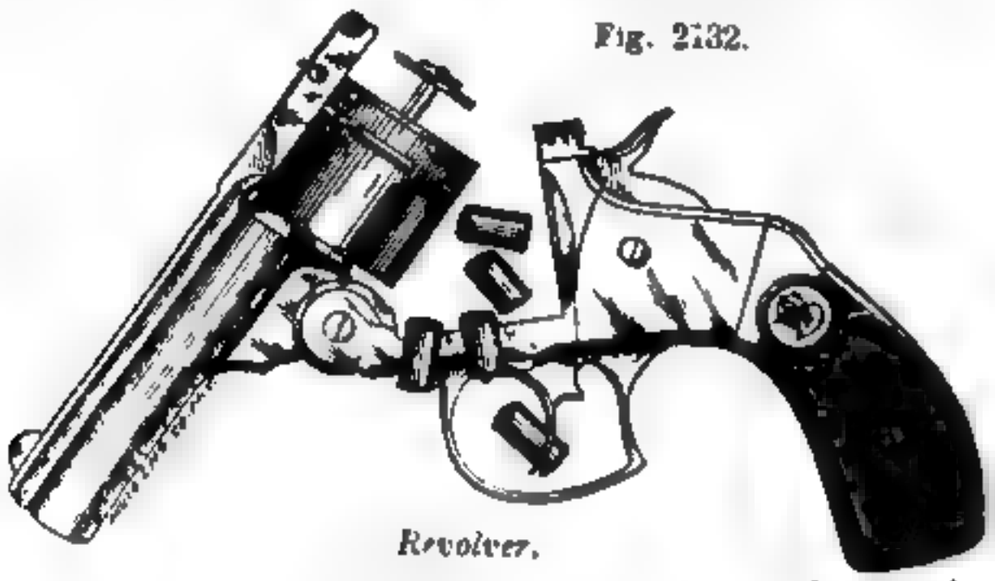
1255 is a five-chambered French flint-lock gun of the eighteenth century.

1256 is a gun of the same date, with six chambers.

Re-vol'ver.

Fig. 2132 is the latest Smith & Wesson revolver with automatic discharge of the spent cartridge capsules. The discharge is moved rearward by the rocking of the barrels on the hinge to uncover the breach, and throws the capsules clear of the barrels. The discharger then returns automatically into place.

Fig. 2132.



Revolver.

The bull dog revolver is a pocket weapon with short barrel and large bore.

Ri'co-chet'. (*Military.*) A mode of firing with small charges and small elevation, resulting in a bounding or skipping of the projectile. In firing at a fortification, sufficient elevation is given to just clear the parapet, so that the ball may bound along the terre-plein or banquette without rising far above its level.

It is used with effect on hard, smooth ground against bodies of troops or such obstacles as abattis; and also upon water, either with round shot or rifle balls. It was introduced by Vauban at the siege of Philipsburg, in 1688.

Ri'fle. 1. (*Fire-arms.*) A fire-arm having the bore spirally grooved, so as to impart a rotary motion to the bullet and cause it to keep one point constantly in front during its flight.

Grooved-bored small-arms are said to have been in use as far back as 1498; these, however, do not seem to have been rifled in the proper acceptation of the term, the grooves being straight and intended merely to prevent fouling of the bore and facilitate cleaning. The grooves were made spiral by Koster of Birmingham, England, about 1620. In Berlin is a rifled cannon of 1664, with 13 grooves, and one in Munich of perhaps equal antiquity has 8 grooves. The French Carabineers had rifled arms in 1692.

Père Daniel, who wrote in 1693, mentions rifling the barrels of small-arms, and the practice was apparently well known at that time.

Rifles were early used by the American settlers in their conflicts with the Indians; and their first successful employment in civilized warfare is said to have been by the colonists in the war of the Revolution.

In the Artillery Museum at Paris is a large assortment of old rifles, comprehending a great diversity of grooves and twists. These exhibit straight grooves and grooves of uniform twist. In some the twist commences near the breech; in others, at the middle of the barrel or toward the muzzle. In some specimens, the grooves make from 1½ to 2 turns in the length of the barrel; nearly two thirds have an even number of grooves, and about three fourths upward of 6 grooves, varying from 7 to 12. Nearly seven eighths have grooves with rounded edges. Much the greater part of the remainder have triangular, but a few have rectangular grooves. None have grooves decreasing in depth from the breech toward the muzzle. This species of groove was introduced by Tamisier, in 1846, but is now general among the shallow-grooved arms intended for discharging expanding bullets. Tamisier also introduced the plan of increasing the twist of the grooves as they approached the muzzle.

With the earlier rifles and until a very recent period, a patch was generally used over the ball, causing it to fit tightly in the bore and take hold of the grooves. This was a somewhat precarious method; and, accordingly, the Brunswick rifle, one of the latest specially adapted for the round ball, was made with but two grooves, into which an annular rib on the ball fitted, compelling it to follow these. Lancaster effected the rotation of the ball by making it and the bore of the gun slightly elliptical in section.

To this succeeded the system invented by Delvigne, and improved by Thouvenet, Tamisier, and Minié, in which an elongated bullet, fitting loosely in the bore, is expanded, so as to fill the grooves. This permitted greater rapidity in loading, and insured the rotation of the projectile. See BULLET, page 401.

Rifling is now generally adopted in small-arms. The number of grooves is usually three. They are made very shallow, and gradually diminish in depth from the breech to the muzzle. The Swiss Federal rifle, introduced in 1848 by Colonel Wurstemburger, has eight grooves with a twist of one turn in three feet. In this the bullet is not expanded, and it has enjoyed a high reputation for accuracy. The caliber is small, .41 inch, the bullet weighing 257 grains, and the powder charge 62 grains. The plan of having studs or ridges on the bullet to engage the grooves has not been extensively adopted for small-arms. The rifle of General Jacobs, East India service, employs a bullet of this class, having four ridges corresponding to the four grooves of the rifle, and used with a patch.

In Murphy's mode, the rifling only extends four inches from the muzzle, and has its pitch left-handed to correct the slight tendency to pull the gun over to the right in pulling the trigger.

The Whitworth rifle has a hexagonal bore; the Westley Richards carbine, an octagonal bore; the Lancaster carbine, an elliptical bore, or it may be described as a spiral of oval section.

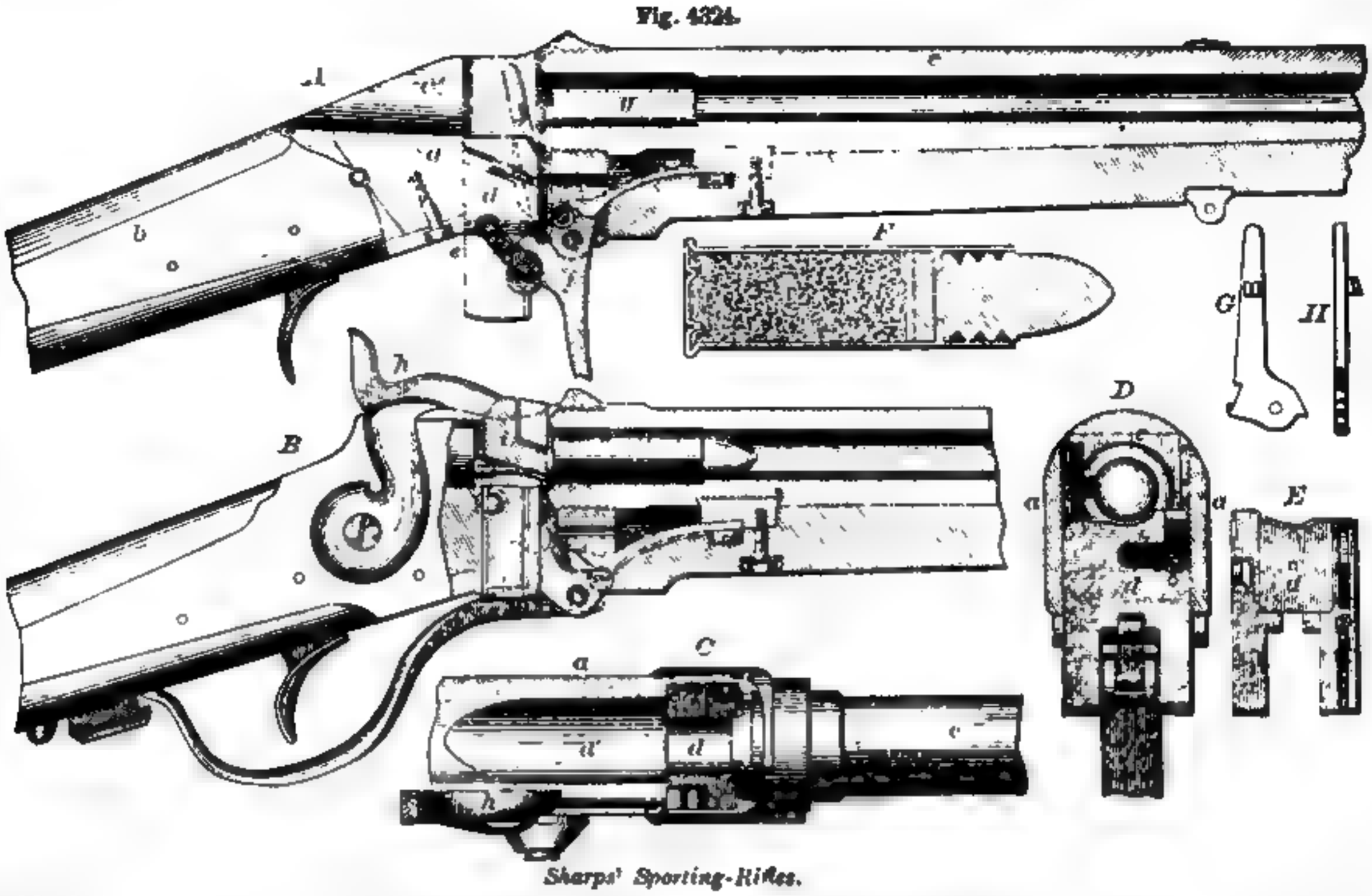
The rifling of gun-barrels in the Remington Works at Ilion, N. Y., is done by a very small cold steel chisel inserted in a long rod firmly attached to a rapidly revolving wheel, which also moves up and down a platform. The barrel is run over this rod and placed firmly in position. As the wheel revolves, the chisel in the rod cuts the rifling in the barrel; and as the wheel advances and retires very rapidly, the twist of the rifling is very elongated.

In breech-loading arms the bullet is of slightly larger diameter than the bore measured from land to land, and *slugs* so as to fill them when driven forward by the ignition of the charge.

See list of breech-loading fire-arms on pages 855–862, and illustrations, Plates XVI., XVII., XVIII. See also BULLET.

Sharps' is one of the very oldest successful guns of the breech-loading class, and the first in which a vertically sliding breech-block was employed. Originally, a paper cartridge was used, the rear end of which was cut off by the sharp forward end of the

Fig. 4324.



Sharps' Sporting-Rifles.

breech-block in its upward movement; a cartridge having its end closed by a thin combustible paper was subsequently substituted for this. At present the metallic cartridge is employed.

In Fig. 4324, *A* is a vertical section of the gun, the parts in loading position; *B*, the parts in firing position; *C*, a top view; *D*, a transverse section, with the breech-block down; *E*, front view of the breech-block, showing in the center the end of the firing-pin, and at the right-hand side the groove occupied by the cartridge-retractor shown by two views at *G H*. *F* is a metallic cartridge in section.

a is the metallic breech-piece, secured to the wooden stock *b*, and into which the barrel *c* screws; *d* is the breech-block, connected by a toggle *e* to the guard-lever *f*, and having a vertical movement within a slot in the breech-piece *a*. The upper surface of the breech-block has a groove *a'* in line with the barrel, serving as a guide for the insertion of the cartridge into the chamber *g* when the breech-block is depressed out of the way. This is effected by throwing down the guard-lever *f*, as shown at *A*. The cartridge is then inserted, and the guard-lever brought back to the position shown in *B*, the hammer *h* having been previously set at half-cock. On depressing the lever the firing-bolt *i* is automatically moved rearward by a spur on its forward end, so as to clear the point of the bolt from the cartridge shell and rear end of the barrel. The shell is retracted by the same movement.

In order to fire, the hammer is set at full cock, and on pulling the trigger, its face comes in contact with the end of the firing-bolt, which is thrown forward, its end impinging against the base of the cartridge where the capsule containing the fulminate is placed.

The firing-bolt is so adjusted that the hammer cannot come in contact with it until the breech is perfectly closed, thus affording a security against premature discharge. The cartridge shells may be used a number of times. The exploded cap is removed, the shell cleansed, a new cap inserted, a charge of powder poured in, over which is placed a paper wad, and a lubricating wad composed of ½ beeswax and ½ sperm oil, and the bullet pressed home with a ball-seater.

Among the best known and most efficient arms of its class is the revolving-rifle of the late Colonel Samuel Colt, who, by the simplicity and ingenuity of his devices and his unceasing care to insure perfection of workmanship and material, first rendered the revolving system a success, and succeeded in producing a weapon which is known and used throughout the world.

In 1830, Colt invented a device "for combining a number of long barrels so as to rotate upon a spindle by the act of cocking the hammer." His improvement on this plan, which consisted in using a rotating cylinder containing several chambers, all of which discharge through one barrel, was patented in England in 1835, and in this country in 1836.

The rifle (*A B C*, Fig. 4292, page 1929) has a steel barrel with seven flat angular grooves. The lock-frame is provided with a bridge *a* above the barrel, and the stock is in two parts *b b'*, called respectively the butt and tip. It is adapted to receive a bayonet. The tip in some cases is dispensed with.

The rod by which the cylinder is secured to the barrel has a ratcheted disk *c'* near its rear end, which is engaged in the act of cocking, by a hook connected with the tumbler, rotating the cylinder and bringing each chamber successively in line with the barrel.

Fig. 4325 shows Maynard's rifle. It may, at the option of the user, be provided with two rifle-barrels of different calibers and a shot-barrel, one of which may be substituted for the other by simply releasing the pin *a* which, with the fixed pin *b*, connects the barrel with the stock and firing mechanism, removing the first barrel and securing the second by placing the pin *b* in the hook and reinserting the pin *a* after bringing the holes in the flanges, one of which is seen at *c*, and the arm *d* (shown in dotted lines) into line. These operations take but very few moments to perform.

The rear end of the barrel is thrown up for this purpose, and also for loading, by turning forward the lever *e*, which also

serves as the trigger-guard. When this is restored to its normal position, it is held by the pin *f* near the small of the stock, and the movement, by means of the arm *d*, draws the breech down into a groove in the metallic part of the stock, where it is in position for firing. Either the forward or backward movement of the trigger-guard *e* places the lock at half-cock, obviating the danger of premature discharge.

The Maynard rifle was perhaps the first in which a metallic cartridge was employed. The report of Major Bell to Colonel Craig, Chief of Ordnance, United States Army, May 16, 1856, describes the firing of Dr. E. Maynard's rifle, charged with a metallic cylindrical water-proof cartridge, and dwells upon the important fact of the coincidence of the axes of the ball and the barrel, obtained by the symmetrical setting of the ball in the metallic shell. The bullet was held in the shell by its exact fit, and without choking the shell upon it. The Maynard coil-primer was then used with it; the nipple and percussion-cap were substituted in 1864; the plunger exploder, in 1873; the Berdan primer, in 1874.

The cartridge cases *g* are of sheet-metal, sufficiently thick to permit their being used an indefinite number of times, and have a thick base, perforated to allow the passage of fire from the primer, which is a cap placed on a nipple slightly recessed within the cavity *g'* of the base. The charge of powder is placed within the case, and with the wad, if one be used, is rammed by the short rod *h*, which also serves for ramming the wad over shot when these are employed.

If ball be used, it is pushed into the case by means of the loader *i*, which has a cylindrical cavity terminating in a hollow conoid fitting the point of the ball and keeping it in truly axial position in the case. The flange at the base of the cartridge enables it to be readily withdrawn from the loader and from the barrel after firing. The device *k* is used for pressing the primer, a shallow, flanged cap, upon the nipple. The cartridge, having been loaded as described, is pushed into the rear of the barrel, which is then depressed by throwing backward the trigger-guard *e* until its loop rests against the stock, the pin *f* entering a hole in the guard. The hammer *l* is drawn back to full cock, and on pulling the trigger the main-spring throws the tumbler forward, causing the hammer to strike the firing-pin *m*, which is projected forward within an aperture in the breech-block *n*, and explodes the primer. The breech-block, backed by the stock in rear of it, sustains the force of the recoil.

The rear sight *o*, pivoted on the small of the stock, is a slide-sight, adapted for long ranges, and is turned down when not in use. The block-sight *p* is used for short distances. The front sight *q* is compound, consisting of an ordinary sight and a globe-sight *q'* turning on a common pivot in a slotted base fixed near the muzzle of the barrel.

The barrel being readily detachable, enables the whole arm to be packed within a space not exceeding the length of the barrel, usually 26 inches.

Fig. 4326 shows a plan of the rifle-grounds at Creedmoor, Long Island, and Fig. 4327 is a sketch of the group of marksmen. The figures on the plan give the distances of the different ranges, and the lower view shows the mode of shooting, which was singular enough with some of the party. One man has the toe of his boot for a rest, another his crossed legs.

The shooting at the contest between the American and the Irish teams was the best on record.

The possible individual score was	180
The possible six-team score was (6 × 180)	1,080
The best individual score (Fulton, American) was	168
The American team score was	934
The Irish team score was	931

The best previous shooting at Wimbledon was 1.204 out of a possible 1,440.

Rifled cannon were first successfully employed during the Franco-Austrian war in Italy, 1859. The Lancaster gun had, however, been tried to some extent during the Crimean war.

They may be divided into four classes: —

1. Guns in which the projectile is made entirely of hard metal, and of section corresponding to and fitting the bore, but having a small windage; such as the Lancaster and Whitworth, just described.

2. Muzzle-loading guns with balls having studs or ribs fitting the grooves; as the Armstrong and others.

3. Muzzle-loading guns having projectiles with expansible cups or envelopes of soft metal, which are forced into the grooves in the act of firing, so as to prevent windage; as Parrott's, Blakeley's, etc.

4. Breech-loading guns. In these the projectile has a soft metal coating, which is forced into the grooves in the same way as the leaden bullets of small-arms; *e. g.* the Prussian and Armstrong's.

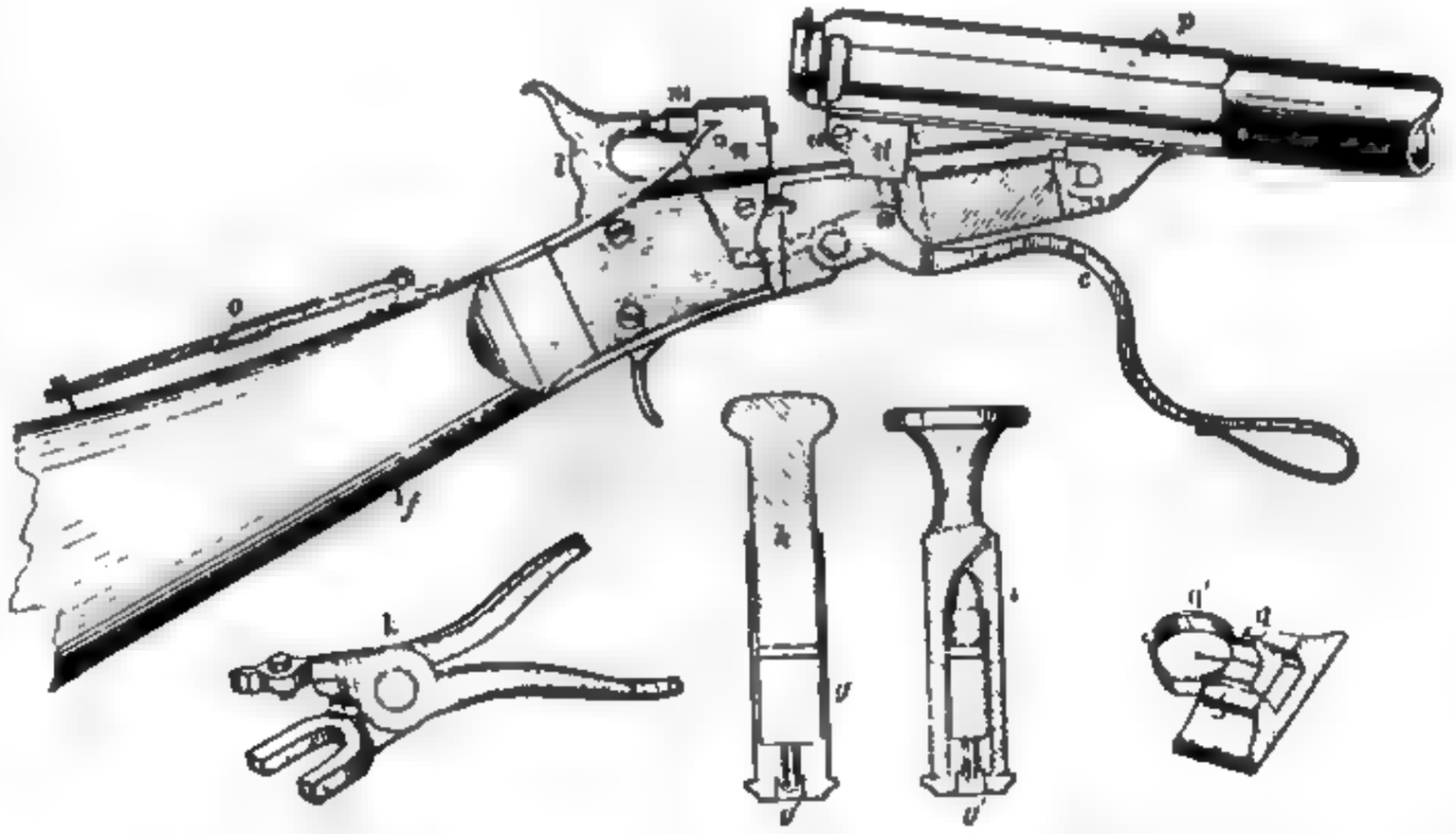
The grooves of the Armstrong muzzle-loader are made deeper on one side than on the other, as shown in Fig. 4328, *a*; the deeper part is of uniform depth and connected with the shallower part by an incline. The studs on the shot are only half the width of the grooves, and of hight sufficient to allow the shot to enter the bore and pass down freely to its seat, as shown at *b*. When driven forward by the force of the discharge, the studs come in contact with the incline, and are *shunted* over into the shallower part of the groove, against which they bear firmly, causing the shot to leave the bore in a line concentric with its axis, as shown at *c*.

In the Scott gun this is effected by making the grooves of gradually decreasing depth from one side to the other (*d*).

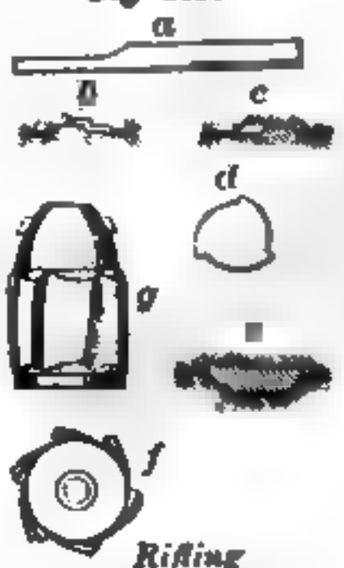
The French system, of which the Woolwich is a modification, is shown at *e*.

The Austrian (*f*) in principle resembles this, the grooves being a series of spiral triangles; the projectile (*g*) has corresponding soft-metal ribs, which readily pass down the bore along the deeper sides of the grooves and are shunted over to the shallower sides when discharged.

Fig 4325.

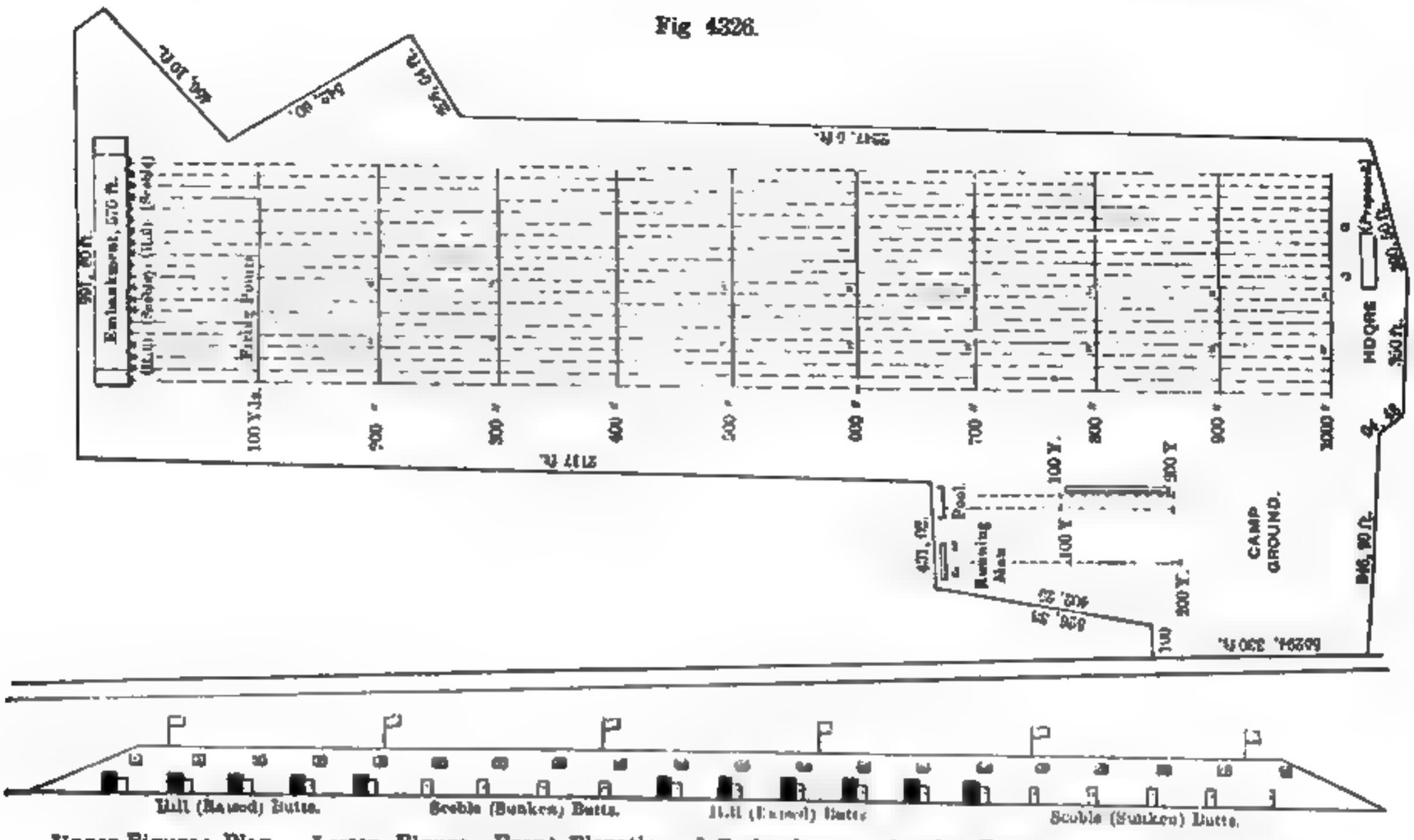


Maynard's Combined Rifle and Shot-Gun. Fig. 4328.



Rifling and Rifle Projectiles.

Fig 4326.



Upper Figure: Plan. Lower Figure: Front Elevation of Embankment, showing Targets as seen from Firing-Points.

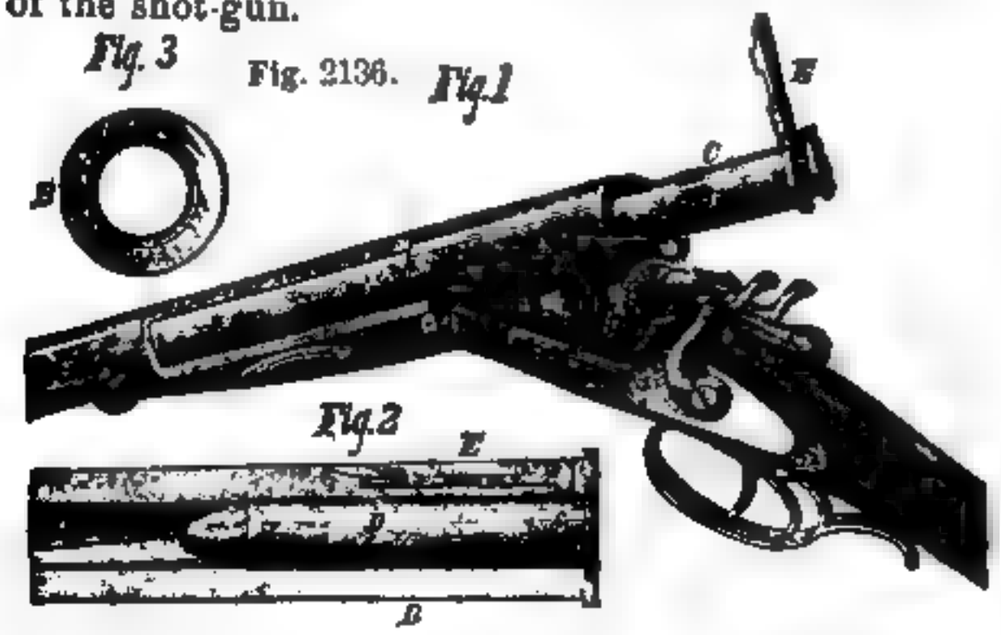
Rifle-Range, Creedmoor, Long Island.

Fig 4327

***American and Irish Teams Shooting at Creedmoor* (1874).**

See also SHELL; BULLET; and specific indexes under ORDNANCE and PROJECTILES.

Fig. 2136 shows Stevens' plan for converting a shot-gun to a rifle by slipping a rifle barrel into that of the shot-gun.



Converting Shot-gun to Rifle.

Fig. 1 is a perspective view.
2 is a longitudinal section.
3 shows the breech of the rifle (enlarged).

The rifle-barrel *E* slips into the rear end of the shot-gun barrel *A*, the flange formed on the end of it occupying the recess made in the shot-gun barrel for the reception of the flange of the cartridge. The rifle barrel has a longitudinal recess for receiving the slide *D* on which is pivoted a lever *E* having at its rear end a short projection, *C*, extending inward.

After the discharge the barrel of the gun is tilted down, and the extractor starts the rifle barrel out of the shot gun barrel; this operation moves the slide *D* slightly, and starts the cartridge shell. Should this prove insufficient the rifle barrel is drawn out far enough to admit of raising the lever *E*, which operation moves the slide *D* and ejects the shell.

Ri'fling Ma-chine'. A machine for making the spiral grooves in the barrels of guns.

As used in the U. S. armories it is a machine in which the barrel is firmly held while a mandrel carrying a cutting tooth is drawn through it, the mandrel making one and a half revolutions during its passage through the barrel. The barrel makes a third of a revolution between each cut, and the result is a barrel with three *grooves* and three *lands*. The

groover is worked automatically, expanding to make the groove deeper as it repeats the cut in the same place, until the groove is deep enough. The barrel is drenched with oil all the time.

The Pratt & Whitney rifling machine gives from one turn to the grooves in 20″ to one in 36″. The cutter-rod carries from 1 to 3 cutters, as the rifling is 4, 5, or 6 to the circumference. An adjustable feed-stop gages the depth of the rifling, and the racks, which are of steel, are double, to take up all back-lash, so that the cutters cannot ride on the lands. An oil-pump feeds automatically at each end of the stroke. The carriage is gibbed on the outside of the long slide, allowing free access to its working parts.

Rim'base. 1. (*Ordnance.*) A short cylinder at the junction of a *trunnion* with the gun. It is an enlargement or shoulder to the trunnion which forms the journal to the piece in elevating or depressing. See CANNON.

2. (*Small-Arms.*) The shoulder on the stock of a musket against which the breech of the barrel rests.

Rock'et. 1. A cylindrical tube of paper or metal filled with a compressed mixture of niter, sulphur, and charcoal, which, on being ignited, propels it forward by the action of the liberated gases against the atmosphere.

Rockets have been known in China and India from time immemorial, and have long been employed for war purposes. It seems probable, from the accounts, that they were employed against the forces of Alexander of Macedon at the farthest point of his Eastern advance.

The first European author by whom they are mentioned is Marcus Græcus, who, writing in the eighth century, says that if a compound of niter, sulphur, and charcoal be tightly rammed into a long narrow tube and set fire to, the tube will fly through the air.

They appear to have been employed against the Crusaders by the Saracens, and were probably first introduced by the former into Western Europe. War-rockets were used by the Venetians in 1380, and by the French in 1449. See GUNPOWDER.

Rockets are used for various purposes: —

War; in which the charge may amount to 32 pounds.

Life-saving: to convey a line to a stranded vessel.

Whale-killing; in which the charge may be 2 or 3 pounds.

Signal; fired straight upward, and not differing essentially from the ordinary.

Sky-rocket: a pyrotechnic device common in public displays.

Sky-rockets differ in their terminal display, which is dependent upon the *garniture* contained in a pot at the head of the case, and which may consist of *stars*, *golden showers*, *serpents*, *jardons*, *vetilles*, *petards*, *saxons*, *crackers*. See Ure, I. 729, 730

These and signal rockets are made by rolling a rectangle of thick paper on a former, whose diameter is equal to the interior of the rocket. The paper is pasted at each turn, and additional sheets are added until the required thickness is attained. The case, as it is termed, is then *choked* near one end by wrapping it with strong twine, which is drawn tightly so as to compress it at that point, but leaving an opening sufficiently large to admit the *spindle*, on which it is placed for driving. The composition employed in the United States military service consists of about 28 parts niter, 5½ sulphur, and 19 charcoal from hard wood, preferably maple.

The niter and sulphur are pulverised, mixed by hand, and passed through a sieve having about 25 wires to the inch; the charcoal, moderately pulverized, is then incorporated by hand.

The case is placed, choke end downward, in a mold; the spindle, which projects upward about ⅔ the length of the case, having been inserted through the choke-hole; a ladleful of composition is poured into the case, and driven by means of a hollow copper-shod drift, which is struck 25 or 30 blows with a wooden mallet, packing the composition into a solid mass; another ladleful is then poured in and similarly driven; several hollow drifts are used, each shorter than the other, until the case has been charged to the top of the spindle, when a solid drift is employed. When the case has been charged to within about one diameter of its top, the charge is covered with a piece of paper, over which is placed a wad of clay or plaster of Paris.

Into this end a paper cylinder, termed a *pot*, is usually inserted for containing the *garniture* or decorations; it projects about 1½ diameters beyond the end of the case, and is surmounted by a paper cone.

The whole is attached to the larger end of a stick of square or rectangular section, and of such taper that the rocket will balance at a point on the stick one or two inches from the case.

The choked end is primed with a piece of quickmatch, and the rocket is fired from a stand which may be adjusted to any desired angle of elevation.

Desaguliers had proposed the use of rockets in modern warfare, but the first actually employed was introduced by Colonel, afterward Sir William, Congreve, in 1808.

The Congreve rocket consists of a sheet-iron case filled with a composition of niter, sulphur, and charcoal pulverised, and having a head which may be either solid or hollow, to contain a bursting charge, and is closed at bottom with a circular piece of gun-metal, having a central aperture, into which the stick is screwed, and smaller surrounding apertures for the escape of gases. If the shell-head be employed, it is provided with a fuse, so as to burst at or before the time of striking. These rockets were first employed in the attack on Boulogne, in 1806, and again at Copenhagen, in 1807. They were also used at the battle of Leipsic, 1813, by the British rocket troop, an organization which is still maintained in that service.

In Hale's rocket, the stick is dispensed with. As originally made, this rocket, which in external appearance resembles Congreve's, had a central aperture at the rear, through which the propelling gas escaped, surrounded by smaller tangential apertures for imparting rotation. These were employed by the United States army in the Mexican campaign of 1847, having been found to give generally as good results as those to which sticks were attached.

It sometimes, however, happened that immediately after starting one would diverge from a straight course and perhaps turn completely over, returning toward the place whence it was fired.

To obviate this, Mr. Hale placed the tangential directing apertures near the head, instead of at the base of the rocket.

The composition with which they are filled consists of niter, 10 parts; sulphur, 2: charcoal, 3. This is inserted in charges of about 3½ ounces each, which are successively compressed by a screw or hydraulic press, under a force of 20 tons or more to the square inch. A hole is bored axially through the composition, and afterward reamed out conically tapering toward the head.

A few rocket-batteries were organized in the early part of the late war, but most, if not all, of the material was subsequently turned into store. Rockets are, in fact, not adapted for use in a wooded country, not being susceptible of great accuracy of aim; and being diverted from their course by the slightest obstacle, they produce but little effect on disciplined troops, and are only available for firing buildings or frightening cavalry horses.

They were, however, used by the English forces in the war against Theodore, king of Abyssinia, — a lineal descendant, according to the tradition of his country, of the Queen of Sheba.

War-rockets are fired from a trough or tube, which has usually a stop near the muzzle end to detain the rocket until sufficient propulsive power is developed to insure its starting in the proper direction.

The tube is sometimes mounted on a tripod-stand and pivoted, so that the required direction and elevation may be given; or it is mounted on a carriage after the manner of a field-piece, in which case it is sometimes called a rocket-gun.

The tube has been made of rods of iron twisted spirally, so as to form a kind of lattice, imparting a rotary motion to the projectile; it has also been proposed to accomplish this object by flanges on the rocket itself.

Ranges.

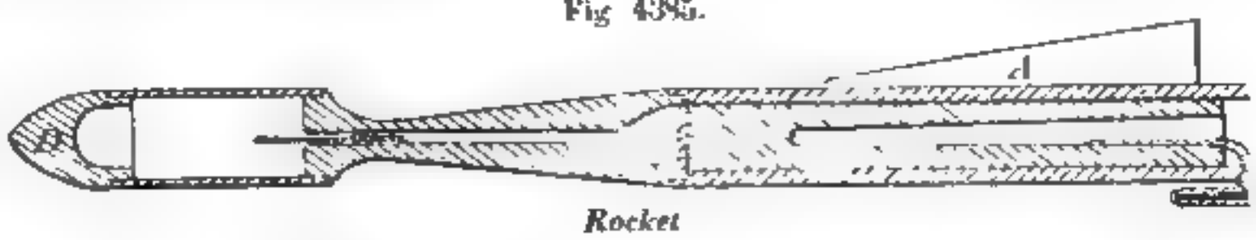
12-pdr.	6-pdr.	Yards.	12-pdr.	6 pdr.	Yards.
...	7½°	400	13½°	11½°	900
	8¼	500	14	12½	1000
10°	9¼	600	14¾	13¼	1100
11¼	10½	700	15	14	1200
12¼	11¼	800	16	14½	1250

When the wind is directly against the direction of flight, half a degree is to be added to, and when directly favorable, the same amount is to be deducted from, the above elevations.

In Hunt's rocket, a stick is dispensed with, rotary motion is imparted by spiral wings on the case or tail-piece *A*, over which is a bursting charge to separate the head *D* therefrom at the termination of the upward flight. The rocket is fired by pulling a lanyard *m*, which draws a slide igniting a friction composition.

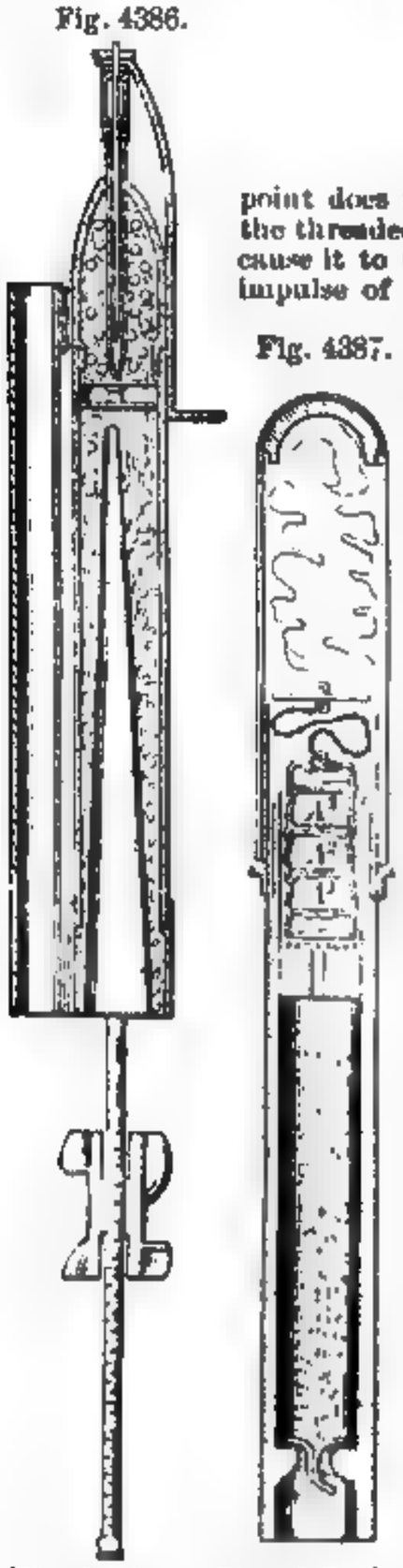
Walbach's rocket has wings and a percussion point, and an elbow to secure discharge if the

Fig 4385.



Rocket

Fig. 4386.



War-Rocket.

Fig. 4387.

Signal-Rocket.

point does not collide. A balancing piece on the threaded tail has spiral projections, which cause it to traverse toward the rear under the impulse of the blazing composition, and preserve the equilibrium as the composition is expended.

Detwiller's rocket has a [illegible] of interchangeable cups A^1 A^2 A^3 containing differently colored fires; these are interchangeable, so as to appear in any required succession when the head is exploded, their various combinations forming signals.

2. The lever whereby the blacksmith's bellows are inflated.

Rock'et-drift. (*Pyrotechny.*) A cylinder of wood tipped with copper, employed for driving rockets. Its diameter is equal to the interior diameter of the case. Several of different lengths are used in charging each rocket, the shorter being employed as the case is gradually filled with composition; the longer have conical perforations to receive the *spindle;* the shortest is solid. Each ladleful of composition is compacted by striking the drift a certain number of blows with a mallet.

Rock'et-har-poon'. (*Weapon.*) A device for killing whales. It consists of a rocket having a pointed shell at its front end containing a bursting charge exploded by a time-fuse. The body of the rocket contains the propelling charge, and to its rear end is attached a barbed harpoon to which the line is fastened. It is fired from a gun or directing tube poised on the shoulder. See GUN-HARPOON.

Rock-fire. (*Pyrotechny.*) An incendiary composition which burns slowly and is difficult to extinguish. Used for setting fire to ships, buildings, etc. It is composed of 3 parts rosin, 4 sulphur, 10 niter, 1 regulus of antimony, 1 turpentine.

Roll'ing-bar'rel. (*Gunpowder.*) A barrel in which the ingredients for making gunpowder are pulverized. It has an axis at each end, on which it rotates, and a door for the introduction and removal of materials. That used for charcoal is of cast-iron, having a series of interior ledges, and that for niter and sulphur of leather stretched on a wooden frame. The material, together with twice its weight of bronze balls, is placed in the barrel, which is rotated from one to eight hours, according to circumstances

Ro'man-can'dle. (*Pyrotechny.*) *a.* A tube (an old gun-barrel sawn off short is best) is partially filled with alternating perforated stars and small charges of gunpowder. Fire communicated to the upper end ignites the charges successively, which throw out the stars until all are discharged.

b. A similar firework in paper tube.

S

Sa'ber. (*Weapon.*) A sword having a curved blade, specially adapted for cutting.

Three kinds are in general use in the armies of Europe and America.

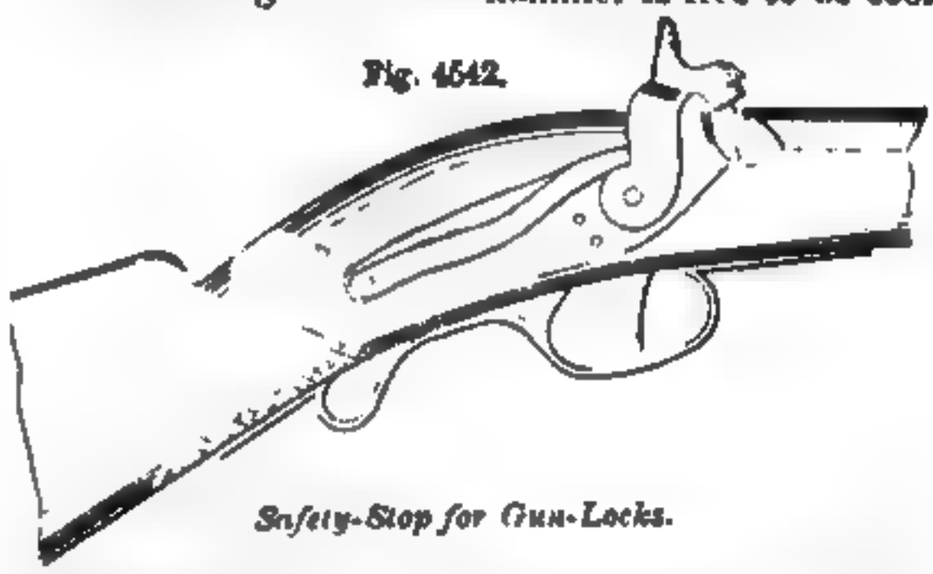
That for heavy cavalry has a slightly curved, heavy blade.

The light-cavalry saber has a lighter blade somewhat more curved.

The horse-artillery saber is still shorter, lighter, and more curved, and has but one branch to the guard.

Safe'ty (*Fire-arms.*) A device to prevent the accidental discharge of a gun. In Fig. 4542, a flat spring catches against the rear of the hammer and locks it against the nipple; when the spring is pressed against the stock, the hammer is free to be cocked.

Fig. 4542.



Safety-Stop for Gun-Locks.

Safe'ty Pin. 1. A temporary pin in a percussion fuse, to prevent the plunger from striking accidentally against the percussion powder. It is held in place by a wire which is ruptured by a weight attached to it when the gun is fired.

Sear. (*Fire-arms.*) The pivoted piece in a gun-lock, which enters the notches of the tumbler to hold the hammer at full or half cock, and is released therefrom by pulling the trigger in the act of firing.

The *half-cock* notch is made so deep that the sear cannot be withdrawn by the trigger.

Seg'ment-shell. (*Ordnance.*) An elongated projectile invented by Sir W. Armstrong.

The iron body is coated with lead, and contains a number of segments of iron in successive rings, leaving a hollow cylinder in the center for the bursting-charge.

The charge bursts on impact or by a time-fuse, and scatters the segments in all directions.

It may be used as case-shot by arranging the fuse to explode the shell on leaving the muzzle.

Shell. 1. (*Ordnance.*) A hollow projectile containing a bursting-charge, which is exploded by a time or percussion fuse. (See CANNON; PROJECTILES; FUSE.) Invented at Venlo, 1495; used by the Turks at the siege of Rhodes, 1522.

Bomb-vessels were constructed in France, 1681.

Shells are usually made of cast-iron, and for mortars and smooth-bore cannon are spherical; but for rifled guns, they are, with the exception of Whitworth's and a few others, cylindrical and have a conoidal point. They are caused to take the grooves in a rifled gun, to receive a rotary motion, by means of a disk or ring, the *sabot*, which is expanded in act of firing, or by studs on the body of the

shell. Those on the Whitworth principle are polygonal in section, corresponding to the bore of the gun, which they accurately fit.

Round shells for guns are made thicker than those for mortars, and have a reinforce at the fuse-hole; in mortar shells this is dispensed with.

The application of the rifled principle and elongated projectiles to cannon attracted little attention until the Franco-Italian war of 1859, where their efficacy was fully demonstrated.

Among the earliest American improvers in this line were James and Read, but no great practical results were achieved until after the beginning of the late civil war, when the talent of a host of inventors was concentrated upon it, resulting in bringing both projectiles and cannon into a very efficient state within a year or so after the beginning of the contest.

Ordnance shells have been constructed in great variety, some depending upon the force of the charge to burst the shell into fragments of indefinite size; others having lines of easy fracture indented in them; others built up of pieces, which become separated when the charge explodes, as the Armstrong; others full of bullets, as the shrapnell.

Among the more prominent American inventions are, —

Sawyer's, 1855 (*a*). This has a layer of soft metal with flanges outside the inner iron shell, which is forced forward by the shock of firing so as to fill the bore, while the flanges take the grooves

Read, 1856 (*b*). Has a wrought-iron cup imbedded in a groove at the base of the shell.

Major Laidley, 1857 (*c*). A metallic jacket surrounds the cylindrical part of the shell, and is attached by being imbedded in a groove or by dowels. Sufficient space is left between the two for the entrance of gas.

Hubbell, 1860 (*d*). A circumferential recess in the shell receives a leaden band, which includes a wire coil and has circumferential grooves to prevent stripping. The whole is covered with canvas.

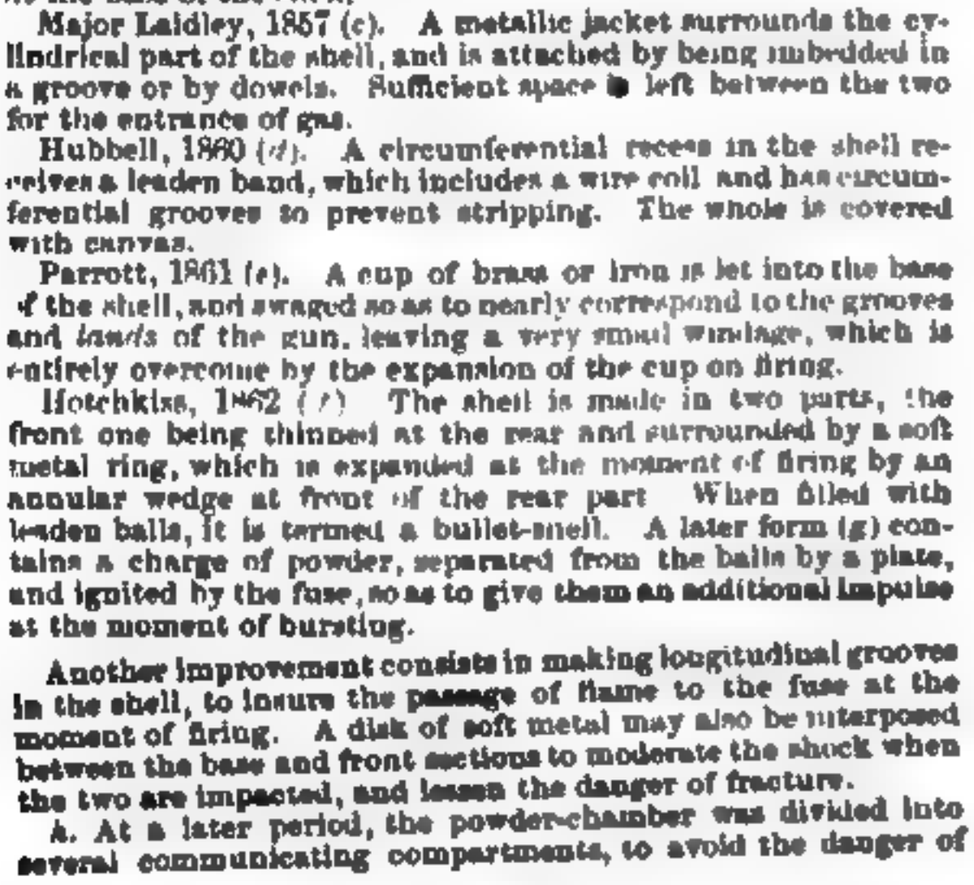
Parrott, 1861 (*e*). A cup of brass or iron is let into the base of the shell, and swaged so as to nearly correspond to the grooves and *lands* of the gun, leaving a very small windage, which is entirely overcome by the expansion of the cup on firing.

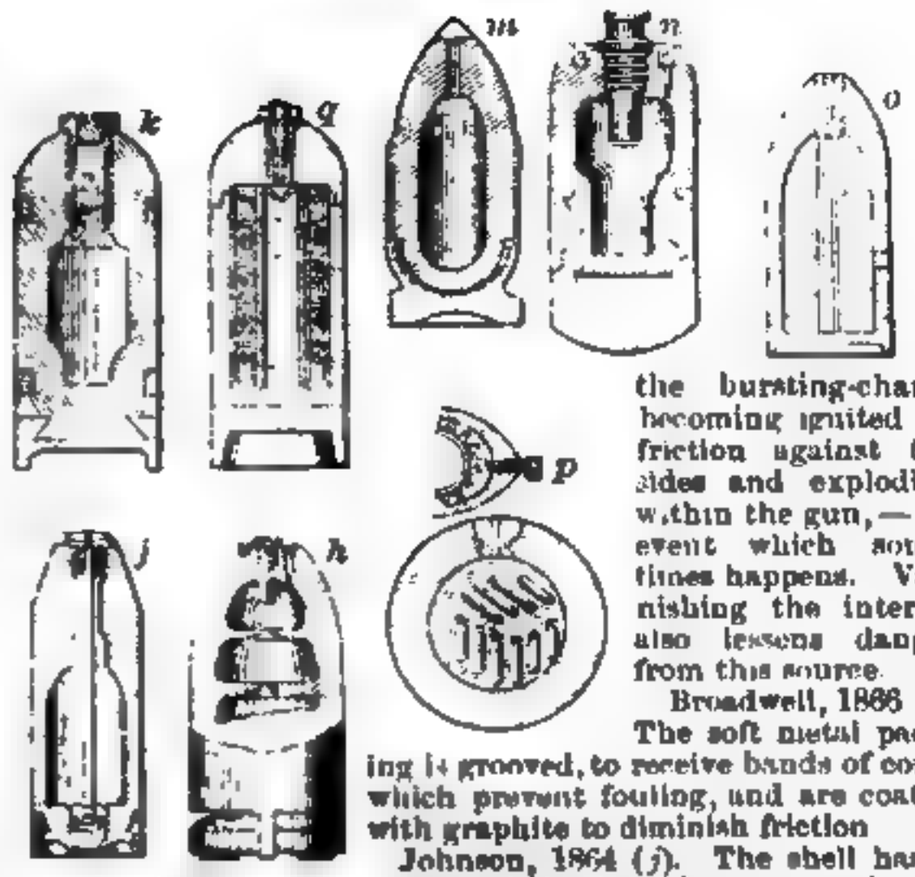
Hotchkiss, 1862 (*f*) The shell is made in two parts, the front one being thinned at the rear and surrounded by a soft metal ring, which is expanded at the moment of firing by an annular wedge at front of the rear part When filled with leaden balls, it is termed a bullet-shell. A later form (*g*) contains a charge of powder, separated from the balls by a plate, and ignited by the fuse, so as to give them an additional impulse at the moment of bursting.

Another improvement consists in making longitudinal grooves in the shell, to insure the passage of flame to the fuse at the moment of firing. A disk of soft metal may also be interposed between the base and front sections to moderate the shock when the two are impacted, and lessen the danger of fracture.

h. At a later period, the powder-chamber was divided into several communicating compartments, to avoid the danger of

Fig. 4979.





Shells.

the bursting-charge becoming ignited by friction against the sides and exploding within the gun, — an event which sometimes happens. Varnishing the interior also lessens danger from this source.

Broadwell, 1863 (*i*). The soft metal packing is grooved, to receive bands of cord, which prevent fouling, and are coated with graphite to diminish friction

Johnson, 1864 (*j*). The shell has a charging-hole closed by a screw-plug at its base. A rod armed with a percussion-cap extends longitudinally through the powder-chamber, and the cap is exploded by an anvil, which is detached from the breech-plug and thrown forward when the shell strikes.

Abterdam, 1864 (*k*), employs one or more bands of an alloy composed of copper and zinc, suddenly cooled after heating, and a cup-shaped sabot cast into a semi-dovetail groove at the [redacted]; this is sawed through in several places to permit its more ready expansion; the bands diminish windage and keep the projectile axially in the bore.

Boekel, 1864 (*l*). A flexible metallic casing fits tightly over the rear part of the shell, extending beyond its base; a cup of less diameter rests against the base, and is imbedded in a soft metal packing

Dahlgren, 1861 (*m*). The cylindrical part of the shell has longitudinal projections fitting the grooves of the gun; and is shouldered to form an abutment for the soft metal sabot, which has an annular groove and is attached to the spheroidal base of the shell.

Hotchkiss, 1865 (*n*). A disk of soft material is interposed between the base-piece and the body of the projectile, to gradually check the forward motion of the base and prevent danger of fracture

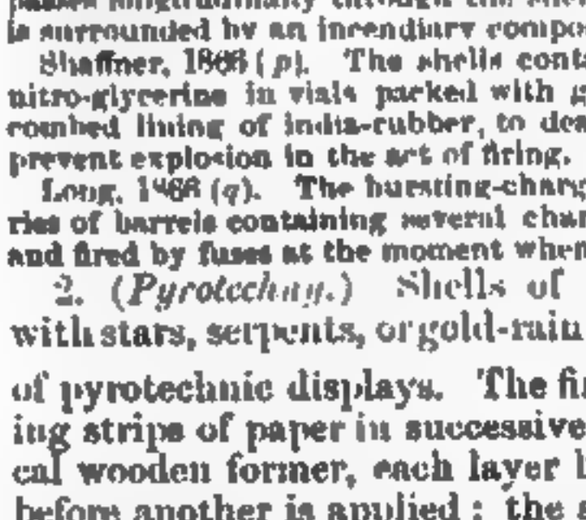
Birnes, 1862 (*o*). A tube containing the bursting-charge passes longitudinally through the shell, resting on its base, and is surrounded by an incendiary composition

Shaffner, 1865 (*p*). The shells contain a bursting-charge of nitro-glycerine in vials packed with gun-cotton and a honey-combed lining of india-rubber, to deaden the concussion and prevent explosion in the act of firing.

Long, 1865 (*q*). The bursting-charge is surrounded by a series of barrels containing several charges of powder and ball, and fired by fuses at the moment when the shell explodes

2. (*Pyrotechny.*) Shells of paper or wood filled with stars, serpents, or gold-rain frequently form a part of pyrotechnic displays. The first are made by pasting strips of paper in successive layers over a spherical wooden former, each layer being allowed to dry before another is applied; the shell is removed from the mold by cutting it into two parts, which are afterward joined by pasting strips over their edges. Wooden shells are turned in two hemispheres out of poplar or other light wood of sufficient size; these are then united in a similar way. Both kinds are provided with a time-fuse, and fired from a mortar with a small charge of powder.

Fig. 4983.



Shell-Gage.

Shell-gage. (*Ordnance.*) An instrument for verifying the thickness of hollow projectiles. It is provided with a set of removable curved arms *a*, each corresponding to a particular kind of shell, which screw

into a socket on the leg *b* of the calipers,

and are inserted within the fuse-hole of the shell. The thickness of the wall is measured between the points of the arm *a* and leg *c*. The arc *d* is graduated so as to show the proper thickness for each caliber, any deviation from which beyond certain limits causes the rejection of the shell.

Shell-hook. (*Ordnance.*) A pair of tongs with hooks which are inserted into the ears of a shell and by which it is carried to the mortar.

Shell Re-du'cer. A device for reducing or expanding a cartridge shell.

The instrument is held in the right hand, open far enough to allow the shell to be entered sideways into its seat, catching the flange under a hook in a top piece and entering the open end of the shell into a die. The handles are then pressed together to reduce the shell at the mouth. By opening the handles the shell will be withdrawn from the die; and as it then may be a little too small it can be brought to the exact size of the bullet by the repetition of the same process, using a plug instead of the die.

Shield. 1. (*Weapon.*) A portable defensive armor carried in front of the person.

The ancient Greek shield, as described by Homer, was long enough to cover the man from the face to the knee. This was exceeded by the *pavise* of the Middle Ages, which was as tall as a man, and was carried by a *pavisor*, who therewith shielded an archer. It was also carried in assaults on fortifications.

The Roman troops were drilled in modes of combining their shields so as to make a carapace, each soldier holding his shield aloft, the shields overlapping in such a manner as to glance off arrows and other missiles. It was called a *testudo*, from its resemblance to the back of a tortoise.

The shield of the Roman legionary was of wood covered with leather, and studded with metal; it was 4 feet by 2½.

The shield of the ancient Briton was round and of basket-work.

The Norman shield was kite or pear shaped

In the time of Edward IV. it had become triangular.

In South Africa it is made of rhinoceros hide.

The shield fell out of use when the broadsword was exchanged for the small sword and rapier. The introduction of fire-arms has farther changed the tactics, and the shield is a thing of the past with civilized nations

It would be a grateful accessory to the sharpshooter under some circumstances.

Shot. 1. (*Fire-arms.*) *a.* Small spherical pellets of lead or *shot metal*, used for shooting birds and other small game.

They were originally made by rolling an ingot of lead into a sheet of a thickness corresponding to the size of the shot to be made, then cutting the lead into cubes and placing the latter in a "tumbler"; the action of the leaden cubes when rubbed against each other in the operation of the apparatus gradually rounding them until brought to a more or less spherical form.

This was superseded by the method now employed of dropping the molten metal, in a finely divided state, from a height into water, invented by Watts, of Bristol, England, about 1782. It is said that he dreamed one night that he was out in a shower of rain, every drop of which was a round pellet of lead. Musing on the matter, he became interested in the question whether such would be the result of dropping melted lead. He accordingly melted some lead, and poured it from the top of St. Mary Redcliffe church into water below. His plan succeeded, and he sold the invention for a handsome sum of money.

The following direction for making shot is found in a work published in the seventeenth century:

"Melt lead down in an iron kettle, skim it, and when it is so hot that it begins to turn greenish, strew as much fine powdered auripigmentum (arsenic) upon it as will lie upon a shilling to every twelve or fifteen pounds of lead, which then must be stirred well, and the auripigmentum will flame. A little may be taken out in a ladle for an essay, and which, when reduced to a proper heat, may be dropped into a glass of water. If the drops prove round and without tails, there is auripigmentum enough therein, and the temper of the heat is as it should be; but, if otherwise, more auripigmentum must be added, and the heat augmented till it be found right."

Small shot is mentioned as hail-shot in many English statutes of the Tudors and Stuarts.

A shot-tower is usually about 180 feet high, and 30 in diameter at bottom, 15 at the upper story, where the melting is conducted in brick furnaces built against the wall around the central opening down which the melted lead is rained into a water-tank at the base of the tower. Platforms with furnaces are also built at lower elevations for making smaller sizes of shot. The method of reducing the lead to a shower of drops is either by pouring it into a sieve or by pouring it out of a wide ladle which has a serrated lip. The lead flows out in a number of streams, which break into separate drops, the resistance of the air and their cohesive tendency causing them to become spherical in falling.

Many of the drops, however, assume an elongated form, and sometimes two or more drops coalesce; these form imperfect shot, which are afterward separated.

The colander-plates are hemispheres of sheet iron about 10 inches in diameter, and the size of the holes is as follows for the respective sizes of shot: —

No. 0, the holes are $\frac{1}{40}$ inch in diameter;
1, the holes are $\frac{1}{52}$ inch in diameter;
2, the holes are $\frac{1}{64}$ inch in diameter,
3, the holes are $\frac{1}{72}$ inch in diameter
4, the holes are $\frac{1}{80}$ inch in diameter,

and in regular gradation to

No. 9, the holes are $\frac{1}{120}$ inch in diameter

The colander is faulty in respect of its delivering the stream at greater velocity when full or nearly so than when nearly empty, owing to the variation in pressure of the metal as it decreases in depth. It is now generally superseded by the ladle, which has a serrated side to divide the lead into streams equal in number to the serrations. Different ladles are used for varying sizes of shot, the serrations being more numerous for small shot and proportionately fewer for shot of larger size.

Fig. 5031.

Lead-Pouring Ladle.

The pourer takes a ladleful (perhaps 20 pounds of melted alloy, — to which arsenic is added to the lead, — and resting it on a bar over the shaft, brings the lead into a quiescent state, scrapes away the oxide from the pouring side, and then carefully tips the ladle, so that the depth of the stream is even throughout the length of the comb, in order that the metal may be delivered in streams of equal size at the several notches. The drops having become partially cooled and consolidated during their fall, are received at the bottom of the tower in a *well* or reservoir filled with water, from whence they are taken and transferred to the drying-machine, where they are lightly rolled between flannel rollers, and when thoroughly dry the elongated and imperfect shot are separated by rolling the whole down a series of inclined planes, each slightly lower than the preceding and separated from it by a slight opening: the perfect ones, having a greater momentum leap the opening, while the defective ones fall through, and are remelted.

The different sizes are then separated by an apparatus resembling a chest of drawers, provided with sieves of different degrees of fineness, to which a shaking motion is imparted.

The shot are finally polished by placing them in revolving cylinders with graphite, by which, and the attrition, a black and shining surface is produced.

In 1849, a process of making shot by dropping the metal through a tube up which a strong current of cold air was driven was patented by Smith. This obviates the use of a high tower.

In 1869, Glasgow and Wood, of St. Louis, patented the making of shot by dropping the molten lead through a column of glycerine or oil, instead of air.

The sizes of drop shot vary with different manufacturers. The following gives the sizes and number of shot to an ounce, of a Baltimore and a New York house: —

Baltimore				New York			
Size.	No. of Pellets to oz.	Size.	No. of Pellets to oz.	Size.	No. of Pellets to oz.	Size.	No. of Pellets to oz.
TTTT	22	4	115	FF	24	4	132
TTT	26	5	140	F	27	5	168
TT	30	6	180	FT	31	6	218
T	34	7	225	1	36	7	291
BBB	39	8	315	BBB	42	8	369
BB	45	9	510	BB	50	9	508
B	52	10	1,130	B	59	10	848
1	60	11	2,200	1	71	11	1,346
2	77	12	3,240	2	86	12	2,326
3	94			3	100		

Buckshot and bullets are made by casting or by compression in dies.

Number of Pellets in an Ounce of Lead Shot of the different Sizes. (HASWELL.)

AA.....40	No. 1 ...82	No. 5.. ..218	No. 9 994
A.....50	2.....112	6.....290	10....1,725
BB 58	3.....135	7.....341	12....2,140
B..... 75	4.....177	8.....600	14....3,150

A Projectile for cannon are also generally termed shot

Ordnance projectiles are, before being issued for service, subjected to a series of tests in order to ascertain if they are sound and of proper dimensions. The instruments required are one large and one small ring-gage, and one cylinder-gage for each caliber, a hammer, and steel punches. The shot or shell is first examined, to see that it has no flaws or other visible imperfections, and is then tried by passing it through the large ring-gage. It must pass through this in all directions, but must not pass at all through the small one. It is then tried by rolling it through the *cylinder-gage*, which is set up endwise at a moderate inclination. If it sticks, it is rejected.

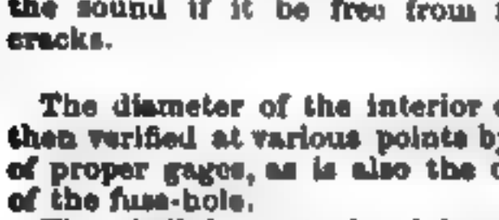
In the case of a hollow projectile farther examination is required. It must be struck with a hammer, to judge by the sound if it be free from flaws or cracks.

The diameter of the interior cavity is then verified at various points by means of proper gages, as is also the diameter of the fuse-hole.

The shell is next placed in a tub of water, the fuse-hole being stopped with a wooden plug having an aperture for the insertion of a pair of bellows. The shell being nearly covered with water, air is forced into its interior by means of the bellows, and if there be any holes in it the air will rise in bubbles through the water. This test also gives another indication of the soundness of the metal, as the parts containing cavities will dry more slowly than the rest

Shot-cartridge. A round of ammunition for a shot-gun. The shot are frequently inclosed in a wire-gauze case to prevent their scattering too much. In the example, a fibrous, elastic tube is tied at one end, and prepared with stearine or similar substance, applied hot in a former; the small shot being inserted, the other end is tied. For breech-loaders, the cartridge is inserted into a copper capsule charged with powder and fulminate, in any usual manner.

Fig. 5032.



Shot-Cartridge.

Shot-gage. A metallic ring with a handle, used for testing cannon projectiles. Two sizes are employed for each caliber.

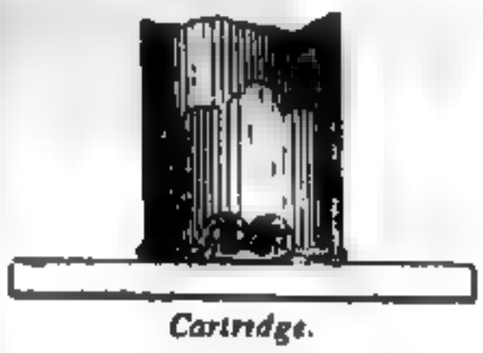
The *large* gage is slightly larger, and the *small* gage a little smaller, than the *true* diameter of the shot or shell, which must pass through the former but not through the latter. It is afterward rolled through a cylindrical gage, any jamming or sticking in which causes the rejection of the projectile.

In the United States ordnance service the first are called *ring-gages*; the latter, *cylinder-gages*.

Shot-gun. A smooth-bore fire-arm for shooting small game. Shot-guns are frequently made double-barreled, and of late years the breech-loading principle of Lefaucheux and others has been extensively introduced. Some breech-loaders, as Maynard's, are provided with interchangeable rifle and shot barrels.

Fig 5033 is the Parker double-barrel, breech-loading gun, made by Messrs Parker Brothers, West Meriden, Conn. *A C* show the barrels and mechanism in loading, and *B* in firing, position. For loading, the breech of the piece is placed under the right arm; by pressing on the finger-piece *a*, the lifter *b* is raised, and its beveled side, coming in contact with the screw *c*, draws the bolt *d* from a mortise in the lug *e*, releasing the barrels, which, turning on the joint *f*, are ready for the insertion of the cartridges. In this position, a small hole in the under side of the bolt comes directly over the trip *f*, which is thrown upward by the spiral spring *g*, and holds it against the lifter, whose top now projects above the frame directly in the line of sight of the gun. After inserting the cartridges, the barrels are brought down by a quick motion with sufficient force to bring the top of the barrel in line with the top of the breech-pin; the bottom of the lug *e* strikes the trip *f*, withdrawing it from the bolt *d*, which then enters the mortise in the lug; the cartridges, coming in contact with the face of the frame, are forced into the chambers, and the gun is ready for firing. As the action of the lifter not only withdraws the bolt from, but forces it into, the mortise of the lug, the fact of the top of the lifter being in place, so that the sportsman can sight along the barrel, affords an assurance that the gun is securely locked.

Fig. 5034.



Cartridge.

An automatic extractor *h* inserted in a hole drilled in the lug and extending around and into the chambers of the barrels, serves to withdraw the cartridge-shells. Its front end rests against a snail on the joint *j*, on which the barrels turn; so that in assuming the position *A C*, it is forced backward, pushing out the shells sufficiently far to be readily withdrawn by the fingers.

The lock is of the rebounding class; the hammer being automatically thrown back to half-cock after firing by an arrangement which effectually prevents accidental discharge. See REBOUNDER.

Fig. 5035.

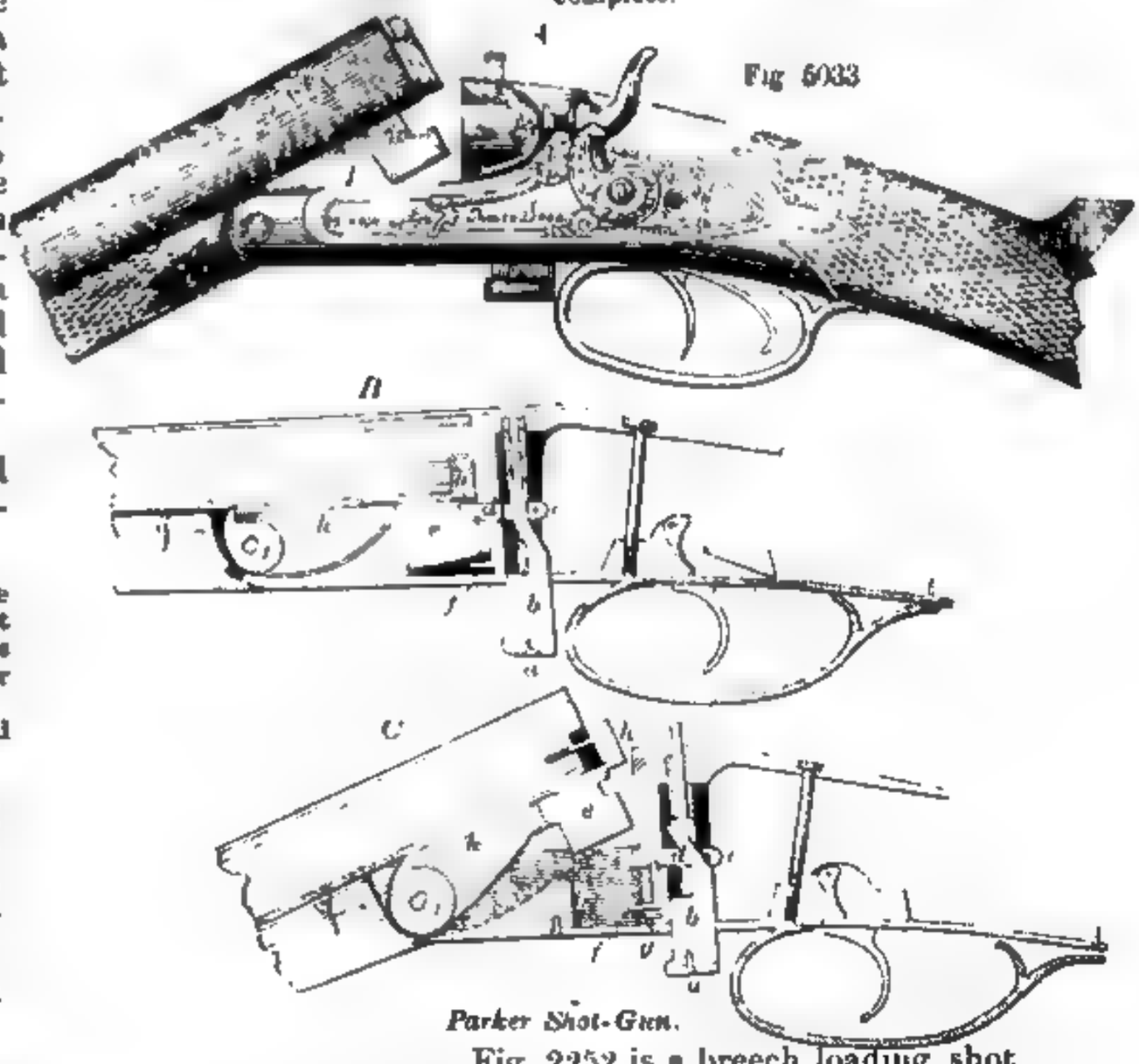
Capper.

Fig. 5034 is the metallic shell used; it is made from one piece of metal, and reinforced by a *strengthener* soldered to its bottom; the Berdan primer is used in connection therewith, and is pressed home upon the nipple, so as not to project beyond the bottom of the shell, by the device (Fig. 5035).

A reversible loading plug is employed, either for charging the shells or withdrawing the caps.

Fig 5036 shows the case containing the gun and its appurtenances complete.

Fig 5033



Parker Shot-Gun.

Fig. 2252 is a breech loading shot gun manufactured at Colt's armory. The parts are interchangeable, and so accurately made that parts of different guns may be intermixed and a gun may be put together from parts taken haphazard. The lock is of the rebounding style, and the firing pins are without springs.

The action bolt which retains the barrel in its place is moved by a lever, back of the hammer, through the medium of internal parts not shown in the engraving. This bolt en-

Fig. 2252

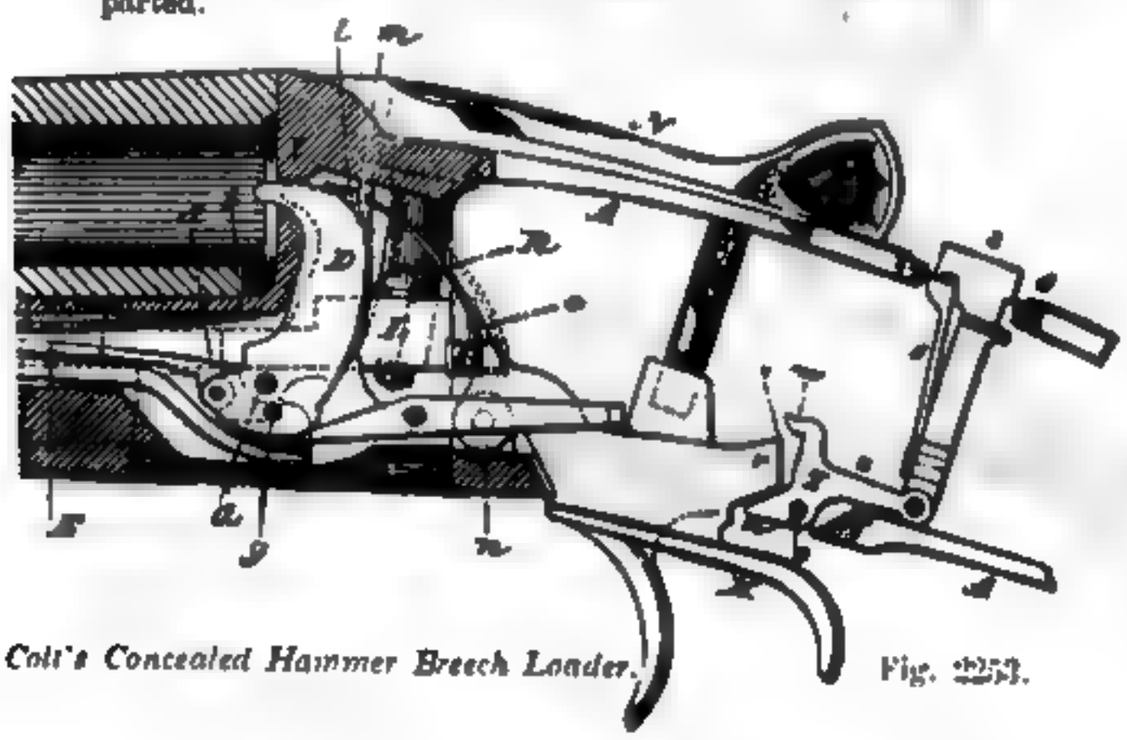
Colt's Breech Loading Shot Gun.

gages two hooks on the barrels and retains the barrels rigidly in place.

The bolt carrying the shell extractors is engaged by a cam on the bolt, connecting the stock and the barrel, and when the barrel is released by drawing the action bolt and tipped as shown in Fig. 2252, the shell extractor is operated.

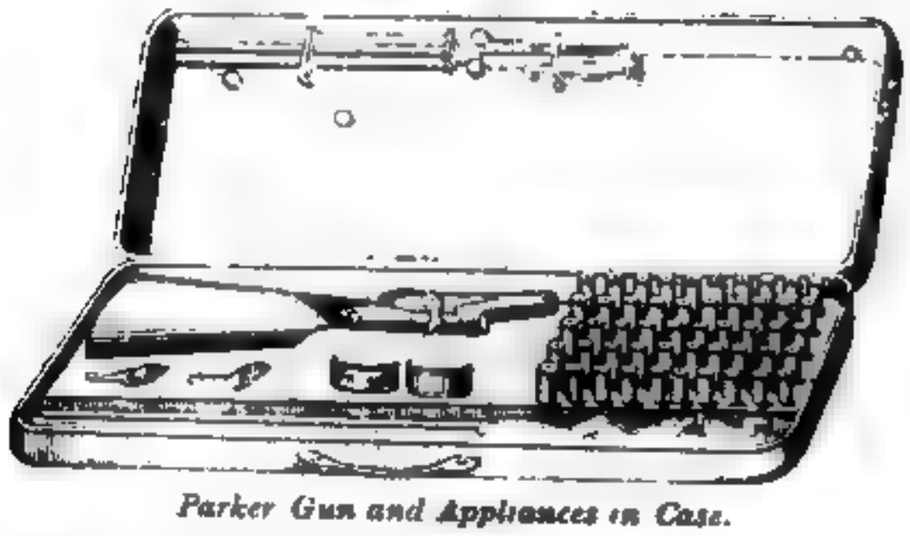
Fig. 2253 shows that form of the Colt shot gun, having concealed hammers which are cocked by the *breaking down* of the barrels. The hammers can be locked in this position, to prevent accidents, by a forward motion of the trigger, and released at will by a forward and downward motion of a stop on top of the stock.

The shield or shell-shaped piece formerly placed upon the breech piece of muzzle-loading guns to prevent particles of the cap from being blown into the eye has been entirely dispensed with upon the Colt gun. It was a curious instance of the persistence of a form after its use has entirely departed.



Colt's Concealed Hammer Breech Loader. Fig. 2253.

Fig. 5036.

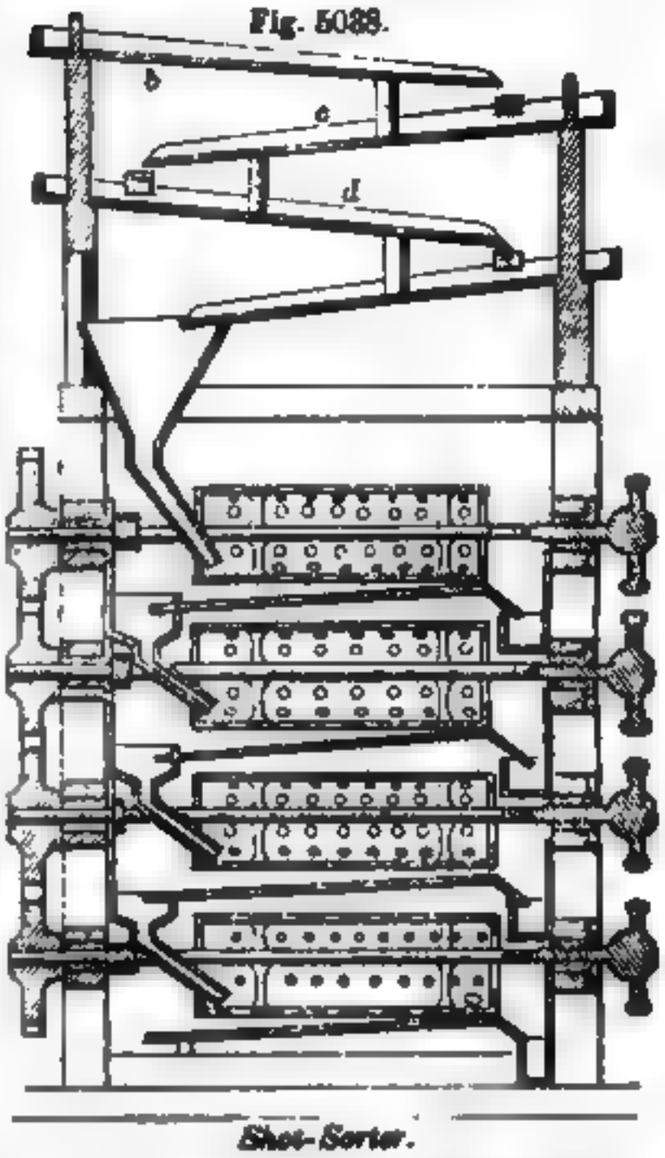


Parker Gun and Appliances in Case.

Shot-met'al. An alloy of lead, 56 parts; arsenic, 1. Used for making bird-shot.

Shot-sort'er. A frame with a series of sieves of different grades of fineness, to sort shot into various grades of size. The imperfect shot are separated by a series of inclines *b c d* with foot-troughs, over which the perfect shot are projected by their velocity, to be afterward assorted in a series of rotary screens of gradually increasing coarseness.

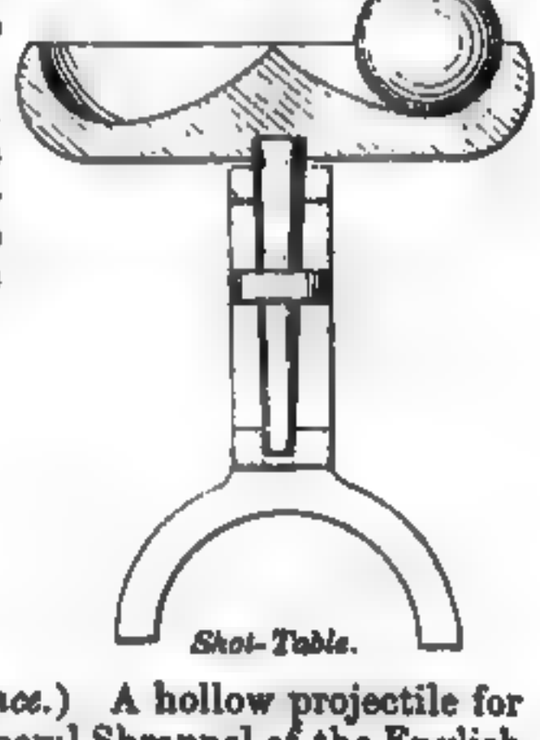
Fig. 5038.



Shot-Sorter.

Shot-ta'ble. A device for insuring the equal shrinkage of shot in all directions while cooling. It has an annularly grooved surface with a conoidal central projection, and turns on an upright spindle. The hollow spherical mold is placed thereon after the cast is made, and rotated until the casting is cool enough to be removed.

Fig. 5039.



Shot-Table.

Shot-tow'er. A tall building from the summit of which melted lead is dropped into a cistern of water. See SHOT.

Shrap'nel. (*Ordnance.*) A hollow projectile for cannon, invented by General Shrapnel of the English artillery.

As originally constructed, the projectile consisted of an iron shell filled with balls, sufficient powder being mingled with the balls to burst the shell when the fuse ignited the charge.

It is also called *spherical case-shot*, and was designed to attain a longer range than common *case-shot* or *grape*.

The bursting charge is designed to be of just sufficient strength to open the shell without scattering the balls, which should continue their flight.

The *improved shrapnel* has its bursting charge in a cylinder in the middle of the shell.

The *diaphragm shrapnel* has its powder-chamber separated from the balls, the interstices between the latter being filled up with coal-dust.

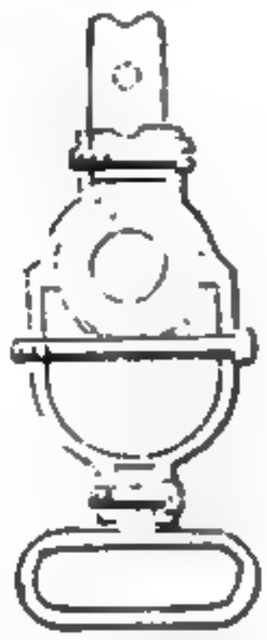
Shrapnel are commonly filled with leaden musket-balls, melted sulphur or bituminous matter is poured in to fill up the interstices, and a chamber sufficiently large to contain the bursting charge is bored out beneath the fuse-hole.

Shunt-gun. (*Ordnance.*) A rifled gun, having two sets of grooves, — one down which the studs on the ball are passed in loading; and another, not so deep, along which the studs pass in discharging, — the ball being shunted from one set to the other at the bottom of the bore.

Sight. 1. (*Ordnance.*) A piece of metal attached or applied to a fire-arm, and by which the arm is pointed at the object. Small-arms have breech and front sights, the former usually notched and the latter pointed. See BREECH-SIGHT; LEAF-SIGHT; FRONT-SIGHT.

Sights for cannon include the breech-sight, front-sight, rimbase-sight, and PENDULUM-HAUSSE (which see). See BACK-SIGHT; MUZZLE-SIGHT; BREECH-SIGHT; TELESCOPIC SIGHT, etc.

Fig. 5079



Sight for Fire-Arms.

The United States service rifle has a *notch* for 100 yards, and two *leaves* for 300 and 500 yards respectively

Fig. 5079 shows a sight for service fire-arms.

2. Some surveying and other instruments of precision have plain-sights, usually consisting of a vertical piece with an opening divided by a spider's thread, hair, or fine wire.

Sig'nal-rock'et. Signal-rockets are composed of a case, charged with composition; a *pot* filled with *stars*, *gold-rain*, or *serpents*, and a stick. They are named from the interior diameter of the case, as ¾-inch, 1-inch, or 1½-inch rockets.

The case is formed of stout paper, which is cut into rectangles in width equal to the length of the case; these are rolled over a wooden former which is of the same diameter as that of the interior of the rocket, the paper is pasted after the first turn, and is drawn around the roller, keeping it perfectly taut as each turn is taken. This is done on a flat table, and successive sheets of paper are added until the required thickness is attained. It is then choked near one end by means of a stout cord wound once around it and drawn taut by means of a treadle, after which the choke is secured by several turns of twine, leaving an aperture large enough for the insertion of the spindle in driving; the case is now dried in the shade.

When dry, the composition may be driven into the case. For this purpose the choke end is cut off square to such a length that when the case is inserted in the mold, the choke shall fit closely over the nipple of the spindle, the end of the case resting on its base; being placed on the spindle, the case is driven firmly down, and the *mold* placed over the case. The mold is a metallic tube, bound with rings; or a block having a circular hole, into which the case fits, may be used for holding the case while driving. For driving, three or more *drifts* are used; these are of the same diameter as the rocket, but of different lengths, and all except the shortest are recessed to receive the spindle.

Fig. 5084.

a, *Mold*, or *Block*. *b*. *Spindle*. *c*, *Drift*. *d*, *Case*.

A ladleful of composition is poured into the case and driven down by 25 or 30 blows of a wooden mallet on the head of the drift, which is then withdrawn, and another ladleful of composition poured in, which is similarly treated: the operation is proceeded with in this way, using the longest hollow drift first, and afterward the shorter ones successively until the top of the spindle is reached. The case is then driven one diameter in hight with the solid drift, the composition covered with a paper wad cut to fit the case, over which is driven a wad of clay about ½ of a diameter in hight.

Cases may be driven without a *mold*, being firmly fastened in an upright position.

The rocket is primed by a piece of quick-match, inserted in the choke-hole and coiled away at the bottom of the composition. A cap of strong paper is then pasted over this end.

The *pot* is a cylinder of rocket-paper, which is slipped over the case at the clay-wad end, projecting about 1½ diameters beyond the end of the case; it contains the ornaments and a bursting charge of powder, and is pasted on to the case.

The *cone* is made by a semicircular piece of thick paper wrapped around a conical wooden former and pasted. This is covered over the end of the pot by a similar cone of thin paper, one inch longer, whose bottom is cut into slips and pasted to the pot.

The stick tapers gradually, being of .6 to .8 of an inch at the large, and .35 to .5 of an inch square at the small end. The large end is that attached to the rocket, and is tied on by means of twine or iron wire. Its length is such that, when attached, the rocket should balance at from about 1 to 2 inches in rear of the case.

These dimensions apply for ¾ to 1½ inch rockets: for larger or smaller ones, they will be nearly in similar proportion to the size.

Marcus Graecus, who wrote about the close of the eighth century, gives the following directions: pulverize in a marble mortar 1 pound sulphur, 2 charcoal, and 6 of saltpeter.; ram some of this powder tightly in a long narrow tube closed at one end, then set on fire, and the tube will fly through the air.

This is a veritable rocket.

Rockets from 3 to 4 inches in diameter [illegible] from 1,000 to 1,200 yards in from 7 to 10 seconds, and are visible 35 to 40 miles. Rockets of 1 or 2 inches diameter only ascend to from 450 to 600 yards.

Skelp. A strip of iron which is bent and welded into a tube to form a gun-barrel, or pipe.

Skelps for gun-barrels were formerly forged, the strip being about 3 feet long and 4 inches wide, thicker at the end for the butt than at the end which forms the muzzle. These *skelps* were afterward bent, lapped at the edges, and welded at several heats.

These forging operations were superseded some years since at Birmingham, England, by rolling processes, which have become general.

For rolling, the circumference of the roller is equal to the length of the skelp, and the shape of the groove is adapted in width and depth to the width and thickness of the skelp.

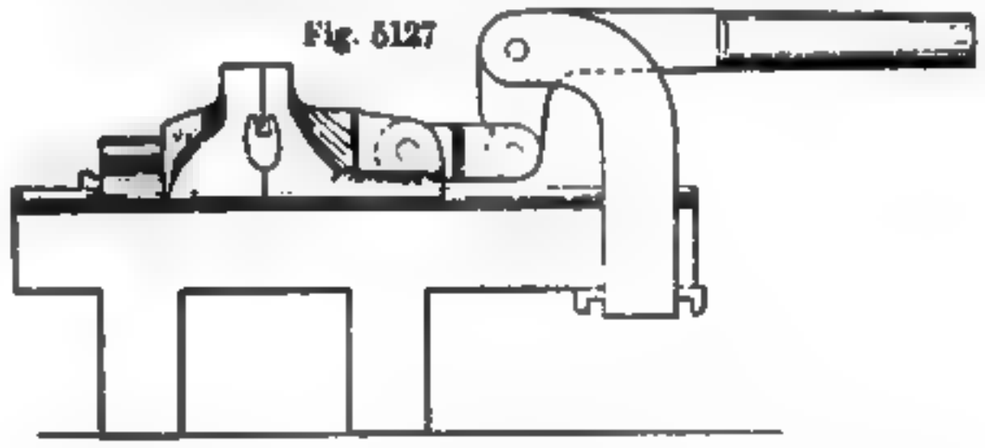
Welding was performed by running the skelp with lapping edges through the circular aperture formed by the semicircular grooves of adjacent rollers. The skelp was brought to a welding heat and placed on a mandrel.

This plan has been modified by making a blank of an extra thickness and combining a drawing and welding action.

A bar of iron about a foot long is bent into a cylindrical shape, the edges overlapping; being raised to a welding heat, it is then slipped over a triblet and passed between a pair of rollers, which weld the edges and draw the cylinder to the length and proportions of a gun-barrel at a single heat.

Skelp-bend'er. A die of required form is made in two parts, so arranged on a slide as to open for the admission of the end of the sheet and be closed

Fig. 5127



Skelp-Bending Machine.

by a lever. The end is then bent up, when it is seized by the proper apparatus and drawn through the die.

Sky-rock'et. (*Pyrotechny.*) A species of fire-work — composed of a mixture of niter, sulphur, and charcoal, tightly rammed in a stout paper case — which is caused to ascend when the compound is ignited at the lower end. It is provided with a stick which is attached to the case at one side.

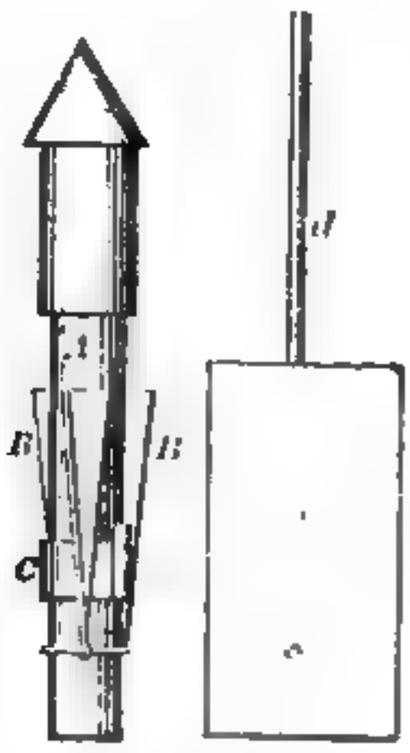
In Fig. 5140, the case *A* has three short sticks *B B* placed equidistantly around it, and attached by wires *a a*.

In Fig. 5141, the case *A* is provided with wings *B B*, which may be folded down when the rocket is packed for transportation. When erected to serve as guides, they are held by a sliding-collar *C*, which is notched to receive them. A rod *d* passing through a loop in the collar serves to hold them in position for being discharged. The stick is dispensed with. See SIGNAL-ROCKET.

Fig 5140.

Sky-rocket.

Fig. 5141.



Sky-rocket.

Sling. 1. (*Weapon.*) A short leathern strap having a string secured to each end, by which a stone is hurled.

The stone lying in the strap, which has a central aperture to receive it, the sling is rapidly whirled, the ends of the two strings being held in the hand, and when one string is released, the stone flies off at a tangent. The velocity is computed from the length of the radius and rate of revolution.

The sling is a weapon of great antiquity, and is still used among some barbarous nations. About 1400 B. C., when the first great dissension occurred among the Israelites, we read that among the 26,000 Benjaminites were "700 chosen men, left-handed; every one could sling stones at an hair-breadth and not miss." Young David was a skillful slinger.

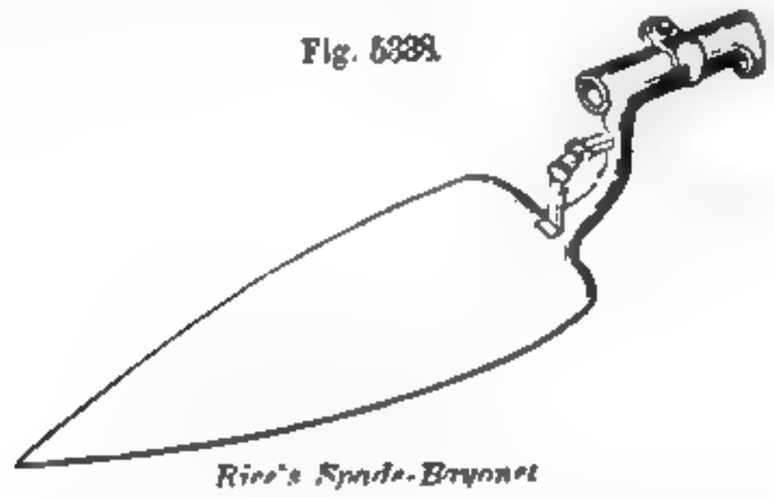
The sling was used by the Phœnicians, Egyptians, and Persians. By the early Greeks it appears to have been but little known, but the light troops of the later Greeks and Romans consisted largely of slingers. The missiles were usually stones, but cast plummets were also used by the Greeks. Such are found on the plain of Marathon.

Stones hurled by hand without slings were often used. The Libyans carried three spears and a bag full of stones.

The inhabitants of the Balearic Isles were famous slingers in the time of Strabo.

The Huguenots used slings at the siege of Sancerre, 1672, to economize powder.

Fig. 5338.



Rice's Spade-Bayonet

Spade-bay'o-net. (*Military.*) A broad-bladed bayonet, which may be used in digging shelter-holes or rifle-pits. A TROWEL-BAYONET (which see).

Spear. 1. (*Weapon.*) A very ancient instrument of war, consisting of a blade on the end of a long shaft. It still survives among savage nations, and under the name of *lance* is used by cavalry among those comparatively civilized.

The spear of antiquity was sometimes provided with the *amentum* or thong for throwing.

Herodotus distinguishes the nationality of some of the nations in the army of Xerxes by describing the peculiar ornaments on the ends of their spear-shafts.

For a dissertation on the spears of the ancients, see article "Hasta," in Smith's "Dictionary of Greek and Roman Antiquities." The spear was the principal weapon of the Macedonian phalanx. The lance was introduced from Tartary into Poland, and thence found its way into the army of Frederick the Great, and into the Austrian service, where its name (*ulan*, from Turkish *oglan*, a youth) indicates its derivation. See LANCE

Sponge.

3. (*Ordnance.*) A mop for cleaning the bore of a cannon after a discharge.

The sponge-head is a wooden cylinder covered with a fabric, of which the warp is hemp and the weft woolen yarn, woven in loops like a Brussels carpet

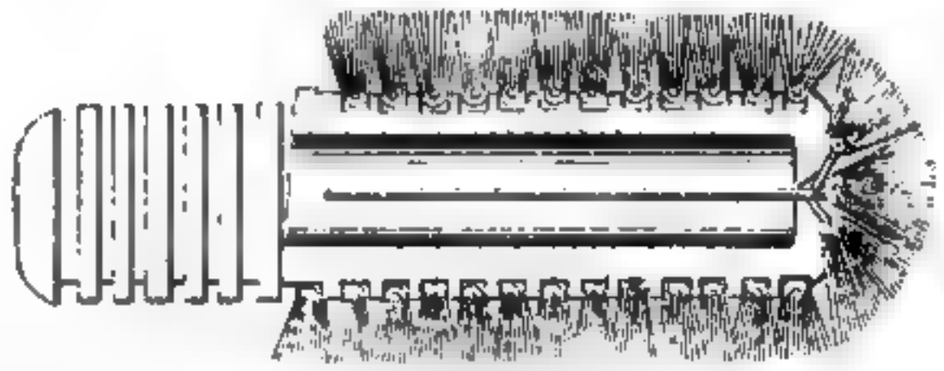
Alum-dressed sheepskin with the wool on is sometimes used.

In field service, the *rammer* is at one end of the staff and the sponge at the other

A rope sponge has a rope staff instead of a stiff one, and is used on shipboard in bad weather when the lower ports cannot be opened for the service of the guns except at the moments of firing.

A hair-brush is used for this service with rifled guns. In the example, a hollow head, as usual, is made to fit the rammer or sponge staff, and a spiral groove is turned on its outside from one end to the other; a mat of horse or horned-cattle hair is then laid around the stock and lashed down by wire wound upon it, over the grooves, imbedding it in the same.

Fig 5462.



Sponge for Cannon.

Spring'al. (*Weapon.*) An ancient form of military engine for throwing stones and darts.

Spring-blade Knife. A pocket-knife whose blade is thrown out or held out by a spring. In the ordinary pocket-knife, the blade is held by the spring in open or closed position.

Fig. 5479.

Spring Dirk-Knife.

In the example, the blade is projected longitudinally from the handle by a spiral spring; catches on the handle maintain it in either its projected or retracted position.

Stan'chion-gun. 1. A small cannon mounted on a pivot.

2. A boat-gun for wild-duck shooting, mounted on the gunwale.

Steam-gun. One whose projectile force is derived from the expansion of steam issuing through a slotted tube.

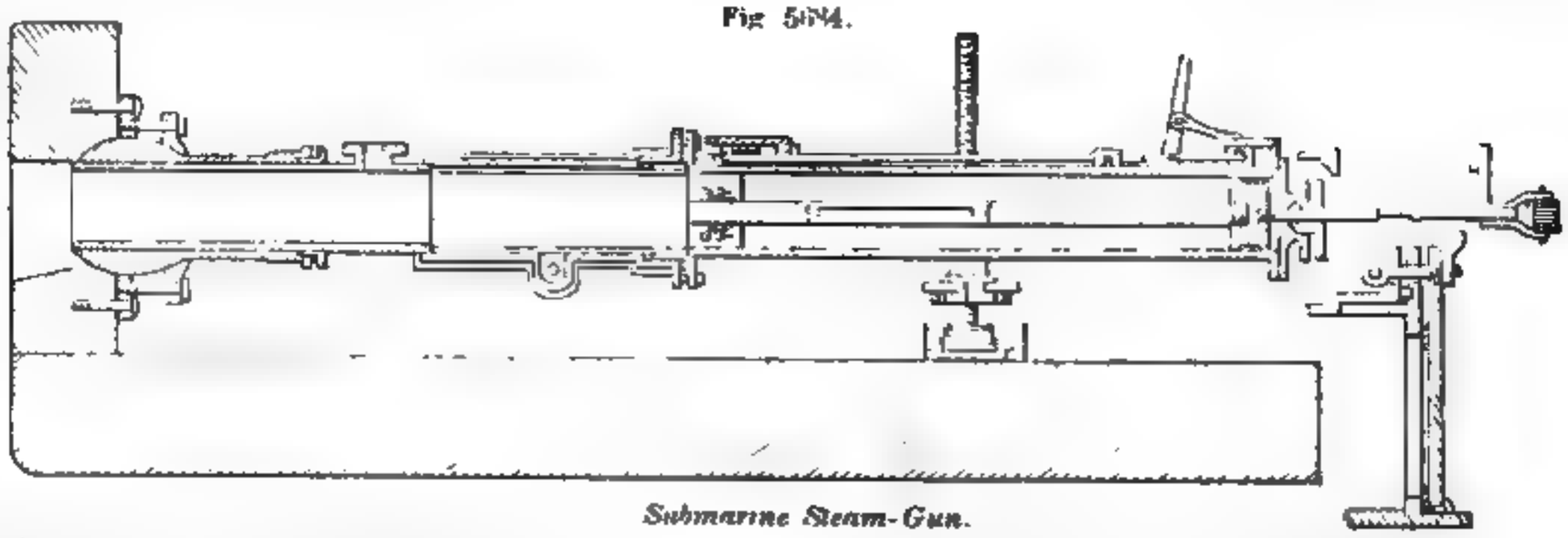
In a manuscript of Leonardo da Vinci, about A. D. 1500, occurs the following: —

"The *architonnere* is a machine made of fine brass, which throws iron balls with great noise and much force. One third of this instrument consists of a great quantity of fire and fuel. When the water is properly heated, the screw on the vessel where the water is must be turned: at that moment the water will escape below, will descend into the heated part of the machine, and be immediately converted into steam so abundant and powerful that the effects of its force and its noise will strike one with amazement. This machine will propel a ball weighing rather more than a talent."

L. da Vinci, in describing this gun, uses Greek terms, and it is surmised that it is the invention of Archimedes. One who has had access to the manuscript states that Da Vinci gives the credit of the invention to the Greek philosopher

A steam-gun is described in Van Etten's "Recreations Mathematique," 1629, 83d Problem. It is a very clumsy contrivance, but used steam acting on a wooden piston or sabot to expel the ball.

Fig. 5684.



Submarine Steam-Gun.

Perkins exhibited a steam gun in England before the Duke of Wellington, 1824. It was very effective, but the "Iron Duke" considered that a steam-boiler that threw away balls as fast as that did would be out of place in an army, and would waste ammunition. The same objection has been until lately urged against the use of breech loading fire-arms. "The men shoot too fast."

Mr. Henry Bessemer's idea is to have a steam fire engine to throw bullets instead of water. He calculates that it will throw 181¼ pounds, representing 2,540 rifle-bullets per minute, to a distance of 1 mile, with a consumption of 5 pounds of coal and 3 gallons of water. "An increase in the weight of the projectile would increase both its range and force, and 2-ounce bullets might be used for a long range, being propelled at the rate of 1,000 a minute. A machine with three parallel barrels could throw 2-ounce shot at long range from the center barrel, and 1-ounce shot (2,000 a minute) at short range from the side barrels."

The calculation for steam at 150 pounds pressure is that it would escape at an initial velocity of 1,900 feet per second, and, acting upon a 2-ounce leaden ball, presenting an area of 6 of an inch, would exert a force upon it of 90 pounds. 1,100 to 1,200 feet per second is the initial velocity of the Armstrong gun projectile. Mr. Bessemer suggests a universal-joint tube for delivering a sweeping fire; and a mantlet to shield the gunners.

Fig 5684 shows the Wood and Lay submarine steam-gun. The side of the ship, below the water line, has an aperture, which is closed by a ball and socket joint. This joint has connected with it a tube, which extends inward, and terminates in a box in which is a trunk with two compartments for containing the shells. This trunk is capable of being moved in the box, so that while one shell is being discharged another can be placed therein. To the rear end of this box a steam cylinder is placed, having a piston therein, which, when the shell is placed in the trunk, has steam admitted in the rear by means of suitable valves, and is pressed forward with such force as to eject the shell and force it to a considerable distance. The piston-rod is hollow, and a cord is passed through it, and is wound around a spool upon its outer end. The opposite end of this cord is secured to the shell, and thus, when the shell has traveled any determined distance, the cord is made to discharge it.

Stink-ball. A nasty pyrotechnic, which makes a suffocating smoke and odor, to be thrown among working parties, or on an enemy's deck at close quarters. It is composed of pitch, rosin, niter, gunpowder, colophony, assafœtida, sulphur, etc. Used by the Chinese and Malay pirates.

STOCK

6. That part of a fire-arm to which the barrel and lock are attached.

The stock of the United States service musket is made of well-seasoned black-walnut. The different parts are shown by their respective letters in the cut.

a, *butt*; the enlarged rear portion having a *cheek-piece* and *heel-plate*.
b, *comb*
c, *handle*, *hand*, or *small*; its length and *bend* or *crook* determine the *fall* or *drop*.
d, head, having a *brass* side and *lock* side.
e, shoulder for lower band. At this point is the *thimble* for the ramrod.
f, shoulder for middle band.
g, shoulder for upper band.
h, shoulder and tenon for tip.
i, bed for lock.

Fig. 5833.

Gun-Stock.

Stub. 1. An old horseshoe nail. Iron formed therefrom. *Stub-iron.*

Stub-iron is used especially for gun-barrels of superior quality. The stubs are put into a tumbling-box to brighten them, removing all rust and dirt. They are then combined with from 12 to 50 per cent of steel in blocks of the same size as the *stubs*. The combined metals are puddled, hammered, heated, tilted, and rolled into ribbons, to be wound in coils around mandrels, heated to a welding heat, *jumped*, and finished by a hammer on the anvil. See GUN-BARREL; TWIST.

Stub-twist. A gun-barrel made of a ribbon of combined iron and steel, the iron being derived from stubs (old horseshoe nails.) See STUB.

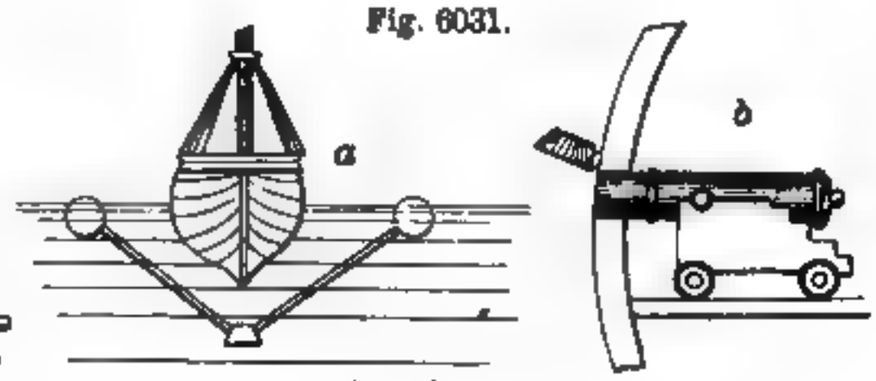
Sub-cal'i-ber Pro-jec'tile. (*Ordnance.*) A projectile for cannon or small-arms, of smaller diameter than the bore of the gun from which it is fired, but having a sabot large enough to fill the bore, allowing the usual windage; or with an expanding sabot, which is forced out so as to fill the bore when the gun is fired.

Sub'ma-rine' Gun. Submarine ordnance seems first to have been suggested by Saint Cyr in 1797, and consisted, as shown at *a*, Fig. 6031, of a mortar towed underneath a vessel by a span extending between two boats.

Fulton experimented with firing guns under water in New York Harbor in 1814, and was successful in penetrating a bulkhead representing the bottom of a first-class ship. His submarine battery of 100-pounder Colombiads is illustrated at *b*. The gun traveled on its carriage, the barrel of the piece slipping in a packed port-hole. The port was closed by a shutter, which was raised by a lanyard and dropped of its own accord when the gun recoiled.

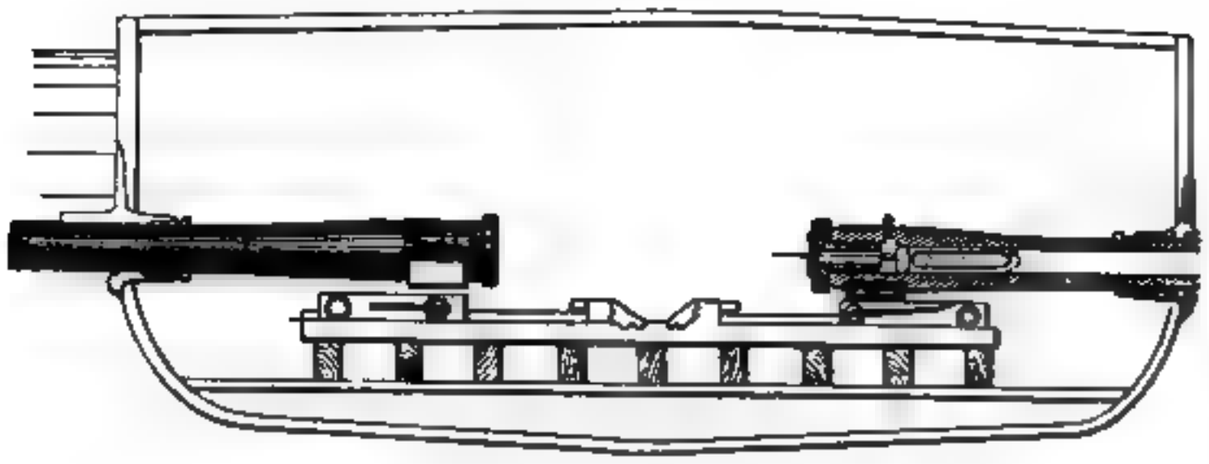
Mr. Phillips of Indiana in 1855, and Woodbury of Boston in 1861–1864, worked at the problem. Woodbury's device is shown at Fig. 6032. An American submarine gun was shown at the French Exposition of 1867.

Fig. 6031.



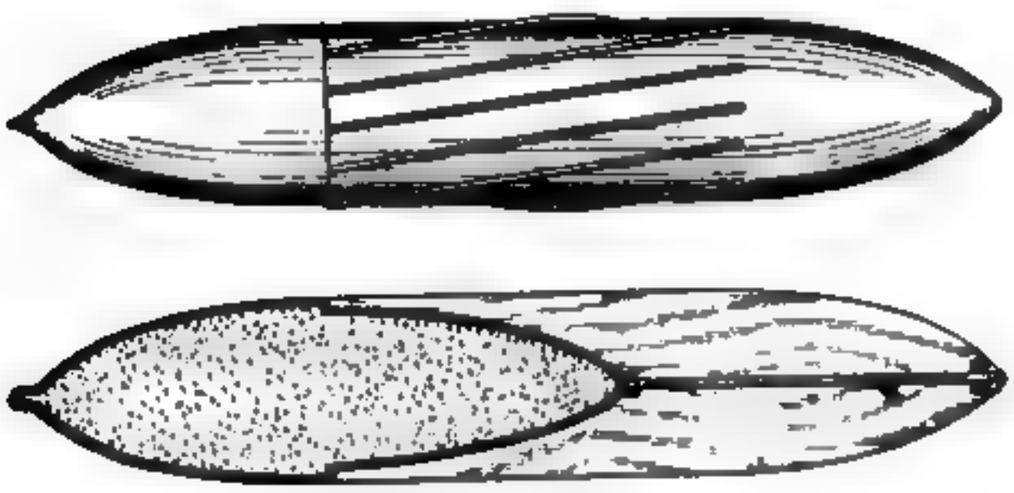
Submarine Guns.

Fig. 6032.



American Submarine Gun.

Fig. 6033.



Submarine Projectile.

Sword. 1. A cut and thrust weapon. Its use is of a very remote antiquity, dating as far back as the bronze age. Stone is not adapted for weapons of this kind, and they have not been found among the relics of peoples unacquainted with the use of metals. Artificers in flint could produce nothing better than a short knife. Swords of iron were made by the Chinese, 1879 B. C. This was about the era of Isaac, and three centuries before Cecrops.

Herodotus speaks of an "antique iron sword" as planted on the top of the mound of worship, used by the Scythians. The position was *phallic*, a form of deification familiar to that whole region. The sword found in the great tomb of Kertch was of iron. Their weapons, however, were usually of bronze.

The swords of the bronze age are always more or less leaf-like in shape, double-edged, sharp-pointed, and intended for stabbing and thrusting rather than for cutting. They have no hand-guards. (LUBBOCK.) *a* is an ancient iron sword, introduced to show the difference in shape. *a* to *k* have solid handles. *b c d* have thin handles intended to have *scales* of wood to round out the hand-hold. The handles are short, and are adapted for the use of a smaller-handed people than the present inhabitants of the lands where these specimens were gathered. *a* is an iron sword from a Saxon tomb, England; *b*, bronze sword from Ireland; *c*, from Sweden; *e*, Switzerland; *f*, Neufchatel; *g*, Scandinavia; *g h i j k*, Denmark.

For the sake of comparison are added: —

l m, spear-heads from Ireland

n o, Irish bronze daggers.

p q, bronze knives from Switzerland.

r, bronze razor-knife from Denmark.

The Egyptian sword was straight and short, from 2½ to 3 feet in length, having a double edge and a sharp point. It was used, as the monuments show, for cut, thrust, or as a dagger. The handle was hollowed in the center, increasing in thickness toward each end, and the end was surmounted by an emblem, such as a hawk's head or the symbol of Phrah.

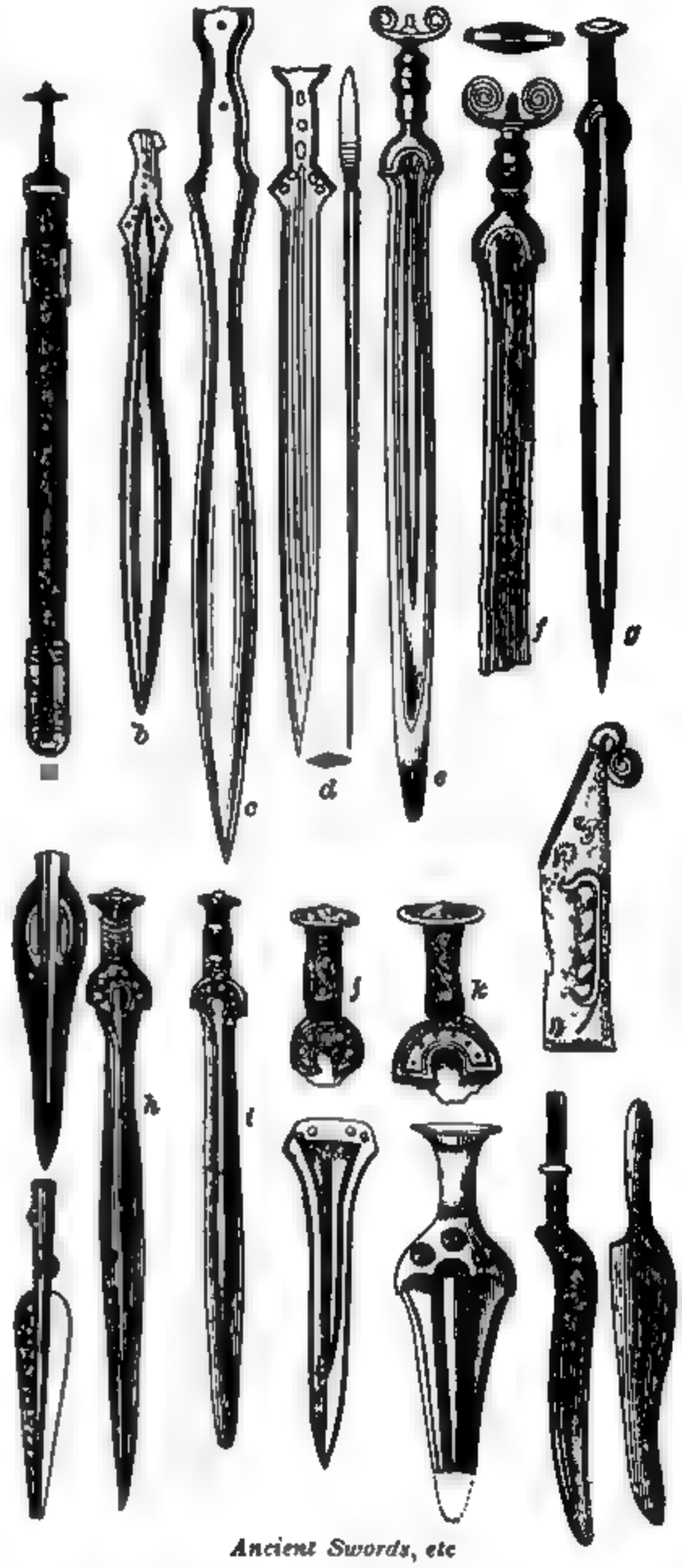
Ages ago the superiority of Damascus blades was proverbial. They were very thin, took an exceedingly keen edge, and were so elastic that they could be bent into a circle without retaining a permanent set. Their surface exhibited a series of fine wavy and spiral lines, which were apparently removed by grinding, but restored by the application of acids. From this circumstance it is inferred that they were, like their modern imitations, made by welding together thin laminæ or wires of iron and steel. The art is said to have been lost to Damascus when it was taken by Tamerlane, who carried away the artificers; and though swords are still made there, they do not enjoy the reputation which tradition assigns to those of the ancient manufacture. See DAMASK; STEEL.

When, A. D. 802, Nicephorus, son of Irene of Byzantium, attempted to throw off the yoke of the Saracens, he sent a letter to the Khalif Haroun al Raschid, in which, alluding to the game of chess, he said, "The queen considered you as a rook, and herself as a pawn," and accompanied the letter with a bundle of swords, which his messengers threw down at the foot of the throne. The Khalif smiled, and drawing his scimeter (*samsamah*), cut asunder the Greek swords before him; then dictated this answer: —

"In the name of the most merciful God! Haroun al Raschid, Commander of the Faithful, to Nicephorus, the Roman dog. I have read thy letter, O thou son of an unbelieving mother. Thou shalt not hear, thou shalt behold my reply."

He ravaged Asia Minor at the head of 300,000 soldiers, and

Fig. 6138.



Ancient Swords, etc

dictated a humiliating peace. About this time Charlemagne was subduing the Slavi of the Elbe and the Avars of Hungary. The king of the Franks at Aix-la-Chapelle received from the great Haroun of Bagdad presents, consisting of the keys of the holy sepulcher, a consecrated standard of Jerusalem, a wheel-clock that struck the hours, an organ, an ape, and an elephant.

Scott, in the "Tales of the Crusaders," describes a meeting between Richard Cœur de Lion and Saladin. Saladin asks Richard to show him the strength for which he is famous, and the Norman monarch responds by severing a bar of iron which lies on the floor of his tent. Saladin says, "I cannot do that," but he takes a down pillow from the sofa, and, drawing his keen blade across it, it falls in two pieces. Richard says: "This is the black art; it is magic; it is the Devil; you cannot cut that

which has no resistance." And Saladin, to show him that such is not the case, takes from his shoulders a scarf which is so light that it almost floats in the air, and, tossing it up, severs it before it can descend. George Thompson states that he saw a man in Calcutta throw a handful of floss silk into the air, and a Hindoo sever it into pieces with his saber.

Europe wondered much at the gorgeous profusion of the Orient, and even the "brand *Excalibur*" must have been of Eastern make, —

"My brand Excalibur
Which was my pride"

"For all the haft twinkled with diamond sparks,
Myriads of topaz-light, and jacinth-work
Of subtlest jewelry"

No wonder Sir Bedivere coveted the sword of this old British chief and hid it "in the many-knotted water-flags," as related in the chronicle of the old harper who is always a little below concert pitch.

The famous sword of Orlando was said to have been the work of the fairies, and its name *Durandal* (*dur en diable*, "as hard as the devil") is indicative of its origin, and accounts for the fact (?) that he was able to cleave the Pyrenees with it. It was also called *Durandarte*, *Durendana*, *Durindana*.

Curtana was another famous sword of Orlando. Its name was given to the "first royal sword" of England from a very early period; in the wardrobe accounts for 1483 it is so designated.

Morglay (*glaive de la mort*) was the sword of Sir Bevis of Southampton.

Tizona was the famous sword of the Cid.

Andrea Ferrara, so long believed to be the name of a celebrated Italian sword-maker, must be given up. *Andrea* is only an occasional prefix, and *Ferrara* is most probably a corruption of *ferrarium*, a weapon-smith, or cutler.

The Lord Mayor of London used to bear three swords, — a *common*, a *Sunday*, and a *pearl* sword. These were *not* famous in chivalric records.

Japanese officials of a certain grade wear two swords, the hilts projecting out a foot in front of the person of the wearer. One of them is a heavy, two-handed weapon, pointed, and sharp as a razor; the other short, like a Roman sword, and kept in the same serviceable state.

Swords and sabers have a *blade*, either straight or curved, with a *tang*, which is inserted into a spindle-shaped piece of wood, covered with leather, and wrapped around with brass wire; these form the *gripe*, which, with the brass knob at the end called the *pommel*, constitutes the *hilt*. The hand is protected by the *guard*, which is a curved piece of metal, consisting of from one to three branches, and usually provided with a broad plate of metal, the guard-plate, at the point where it is attached to the blade.

The scabbard is the case, usually of leather or steel, into which the blade is inserted.

The blade of a sword consists of: The *tang*, which enters the hilt; the *shoulder*, which abuts against the end of the hilt; the *forte*, the half of the blade nearest the hilt; the *feible*, or *foible*, the half part nearest the point; the *point*; the *back*; the *flat*; the *edge*.

The hilt consists of (the parts varying in different kinds of swords): The *pommel*, or back piece; the *gripe*; the *bars* of the basket, in sabers; the *stool*, or *guard*-plate; the *bow*, in sergeants' swords and horse-artillery sabers; the *cross*, as in the old Highland claymore; the *linguets*, in foils and rapiers.

The successive operations in sword-making are forging, hammering, swaging, hardening, tempering, setting, grinding, glazing, hilting, and proving.

In the process of making swords, as practiced at the factories, pieces of Sheffield steel called *double moids*, each of the length of two blades, the ends for the tangs being of iron, are employed. These are cut or broken in the middle, the tangs are forged first, and afterward the blade, the furrow or furrows being formed at the same time. Twenty-five reheatings are required for this purpose. The blade is then heated and plunged into cold water, rendering the metal extremely brittle; again heated, and the distortions caused by the hardening corrected by rehammering, when it is again heated till its surface assumes the proper color, of which the workman is the judge, to insure its having the due hardness and flexibility when tempered, which is done by plunging it at this stage into cold water.

It is next ground. The stones employed for finishing the furrows have raised flutings suited to the furrows of the particular kind of blade to be operated on.

The polishing is performed upon wheels of various sizes, with lard-oil and flour of emery, the blade being frequently dipped into lime-dust during the operation. A brush-wheel, sprinkled with fine crocus-powder, imparts the final polish. The scabbards, if of metal, the hilts, and other metallic parts are treated in like manner.

In making the metallic scabbard, a piece of sheet-steel is laid over the top of an open vise, and beaten with a wedge-shaped wooden mallet, causing the edges to approach each other. The sides are then beaten on each side until the edges nearly unite, and the scabbard is slipped upon a mandrel and hammered until the joint is closed; it is then soldered, and the tip, or *drag*, and the bands are put on.

The *gripe*, or handle, is made of walnut, with a metallic strip at the back; it is shaped by files, a tenon for the ferrule made at the end, and *balled*, that is, surrounded with grooves, by means of a triangular file: the edges of these grooves being afterward rounded, or "balled," with another file. It is then drilled in a lathe, with a longitudinal hole for the tang, after which it is covered with dogfish-skin, secured by winding cord or wire around the gripe in the grooves between the balls.

The hilt, or guard, is cut from sheet-metal, and hammered into shape, then polished, and finally fixed to the sword. This operation is called mounting.

Sword-blades, resembling those of Damascus, are made at Solingen, in Germany. A fagot is first formed of alternate fine bars of iron and steel. It is drawn out, doubled, and twisted several times, and then formed into a ribbon. Two such ribbons are welded together, inclosing between them a thin blade of the best-cutting English steel. After polishing it, it is dipped in diluted sulphuric acid, to give it a pattern.

Sword-blades, resembling in appearance the Oriental blades, and equal to them in quality, have been made in Germany, by the process of Prof. Crevilli, of Milan.

"A long, flat piece of malleable steel, 1½ inches in breadth and ¼ inch in thickness, is first bound with iron wire, at intervals of ¼ inch. The iron and steel are then incorporated by welding, and repeated additions (10 to 20) of iron wire made to the forging, in the same manner as the first. The forging is then stretched, doubled, and welded; and the process is repeated as often as may be desired, when the material is brought to the shape required by the hammer on the anvil.

"By filing semicircular grooves on both sides of the blade, and again subjecting it to the hammer, a beautiful rosette-shaped damask is obtained. By special manipulation the pattern may be made to assume other forms. The pattern is brought out by the application of aqua fortis and vinegar. An idea of the extraordinary tenacity of these blades may be formed from the fact, that out of 210 blades examined by a military commission, and each of which was required to bear three cuts against iron and two against a flat wooden table, not a single one snapped or had its edge indented."

T

Tape-pri'mer. A narrow strip of flexible material, usually paper, containing small charges of fulminating composition at short and equal intervals apart, and covered with a water-proof composition, as the Maynard primer. It was never much favored in the service, and has been superseded by the plan of placing the fulminate within the cartridge.

The tape-primer required a peculiar lock, having a recess for containing the tape and mechanism for advancing each primer successively to the nipple.

Tel'e-scope Sight. (*Fire-arms.*) A telescope mounted on a fire-arm. It is generally adjustable, in altitude for distance; in azimuth for wind correction.

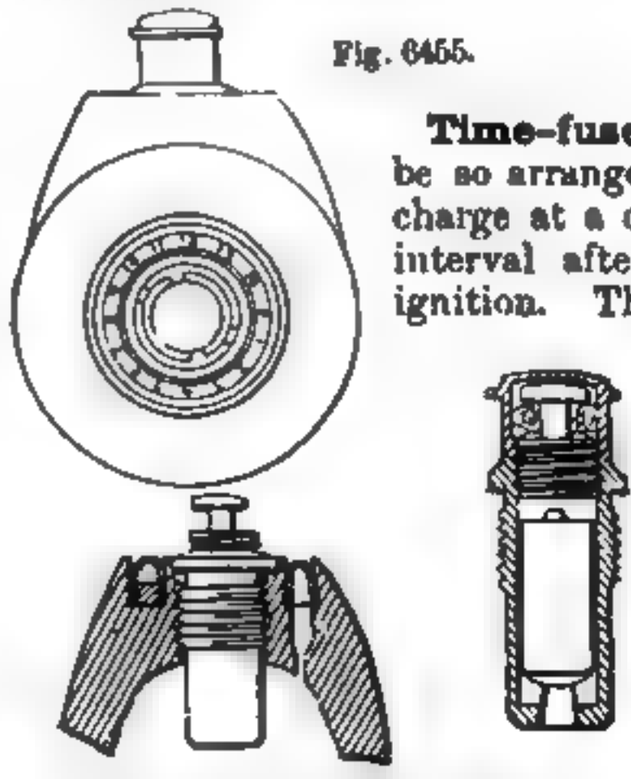


Fig. 6455.

Time and Percussion Fuse for Explosive Shells.

Time-fuse. A fuse which can be so arranged as to explode a charge at a certain determinate interval after the time of its ignition. This is usually effected either by cutting out or off a portion of the fuse or by employing compositions of which given lengths burn at different rates.

Fig 6455 shows a "Borman" fuse, which at the discharging point is in contact with a chamber containing quick powder, and communicating with

the interior charge of the shell. See also Fuse, Fig. 2133.

To'nite. Dry nitrated gun cotton. Density 1.50, about the same as dynamite, and occupies in a blast-hole ⅔ the space of compressed gun cotton. Sold as a dense dry cartridge.

"*London Mining Journal*," 1878. See also "*Engineer*," 1878.

As made at Fernham, England, it consists of finely divided or macerated gun cotton compounded with about the same weight of nitrate of baryta. The gun cotton itself is mainly common cotton waste steeped in nitric acid, and on the excess being forced out by a hydraulic press or otherwise, it is left some time for digestion in vessels of clay. While moist, it is macerated between crushing rollers and then washed. The *rationale* of the latter process is a secret.

As stated above, tonite consists of this macerated gun cotton intimately mixed up between edge-runners with about the same weight of nitrate of baryta. It is pressed into candle-shaped cartridges, with a receiver at one end for the reception of a fulminate of mercury detonator.

Tor-pe'do. A movable chamber or mine charged with an explosive which is fired by contact or by fuse.

They are here divided into

1. Nautical.
2. Military.
3. Oil-well.
4. Railway.
5. Fishing.
6. Toy.

1. (*Nautical.*) Torpedoes are of four classes, —

a. *Drifting.*
b. *Anchored.*
c. *Boom.*
d. *Maneuvered.*

The drifting and anchored preceded the boom and maneuvered, and are adapted for circumstances and positions where (*a*) they may be allowed to drift with the stream or tide against a vessel in a river or channel or at anchor; or (*b*) may be placed in the path of a vessel, or in the line of attack.

The maneuvered class is adapted to be navigated usually beneath the surface of the water, its course and depth being determined and regulated by various devices to bring it in contact with the ship against which it is directed. The *torpedo* perishes in the explosion; the *torpedo*-boat, on the contrary, carries a torpedo, and either explodes it against the enemy's vessel in such a manner as not itself to suffer in the contact, or launches it against the vessel after attaining such a degree of proximity as to insure the aim and power of navigation of the torpedo. See TORPEDO-BOAT.

Several terms used in practice are rather general than accurately technical, as they denote whole classes. Such are, —

Magnetic torpedo, one exploded by electro-magnetism, by spark, wire, or ignited pencil-line in a fuse; in contradistinction to one fired by contact, clock-work, etc.

Submarine torpedo, one placed beneath the surface of the water.

Can-torpedo, one in a metallic caisson.

Laniard-torpedo, one pulled off by a laniard, etc.

In the early instances, floating mines were used in breaking booms, bridges, or other obstructions to navigation, as well as in breaking a cordon of ships or destroying a fleet in port.

In 1585 four floating mines were sent from Antwerp by Zambelli, against a bridge across the Scheldt, erected by the Duke of Parma. Each flat-boat of about eighty tons' burden was stowed with 7,000 pounds of powder confined by mason-work and heavy stones. The mines were to be exploded by a match-rope and by clock-work. One was successful, and made a breach of 200 feet in the bridge, doing immense damage in the vicinity.

September 30, 1628, the English employed floating tin caissons of powder against the French at Rochelle. One exploded against a vessel without seriously damaging it. The others were intercepted.

"In the afternoon come the German, Dr. Knuffler, to discourse with us about his engine to blow up ships. We doubted not the matter of fact, it being tried in Cromwell's time, but the safety of carrying them in ships." — PEPYS's *Diary*, 1662.

In 1688 an immense floating bomb was prepared by the French against the port of Algiers, but was not used.

In 1693–95 similar contrivances were used by the English in besieging St. Malo, Dieppe, and Dunkirk, without serious dam-

In 1770 the Russians burned the Turkish fleet in the port of Tchesme, and destroyed the fortifications by the shock of the explosion.

In 1804 the loaded catamarans of Fulton were used by the English against the French fleet off Boulogne But little damage was done.

The experiments were repeated again and again against Le Forte Rouge at Calais, 1804 (Fulton blew up the brig "Dorothea" in Walmer Roads, October, 1805 See Fulton's "Torpedo War," and "Torpedoes, their Invention and Use," by W. R. King, U. S. A., 1866, Plates XVIII., XIX); Rochefort, 1809; the pontoon bridges of the French on the Danube, at Essling; in 1813, by the Austrians in attempting to destroy the bridges across the Elbe at Koenigstein.

About 1843 Colonel S. Colt constructed a torpedo with which he blew up a ship in the Eastern Branch of the Potomac River, near the Washington Navy Yard; it is believed that the most important feature of this consisted in the application of electro-magnetism as a means of exploding the contained powder.

Torpedoes were extensively employed by the Russians during the Crimean war as a defense for the harbor of Cronstadt. These were suspended from buoys to which they were connected by pipes inclosing at their upper part a small glass tube containing sulphuric acid; on the buoy being touched by a passing vessel, the tube would be broken and the sulphuric acid come in contact with chlorate of potash in the lower part of the pipe, causing its immediate inflammation and consequent explosion of the gunpowder in the magazine.

The experiment of the "Louisiana" before Fort Fisher in 1864 is one of the latest instances. Two hundred and fifteen tons of powder were stowed on board. A tier of barrels, with the upper heads removed, were covered by 90-pound canvas bags. A Gomez fuse was woven through the mass. Three modes of explosion were adopted. — clock-work and percussion, candles, slow-match. The vessel was towed within 351 yards of the works, and exploded in one hour and fifty-two minutes, without doing any damage whatever to the fort. See *infra*, Fig. 6560.

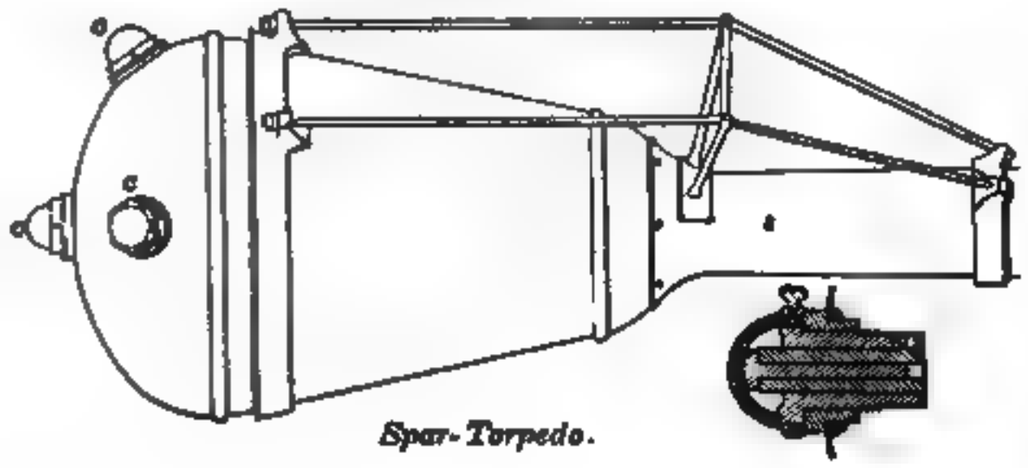
a. The *drifting* torpedo is of various forms, and in its mode of action it is carried against the enemy's works or vessels by the current of the river, the set of the tide, or the drift of the wind.

They may be divided into *can* or *buoy* torpedoes, according to shape; *laniard*-torpedoes, which are pulled off by a cord; *hydrogen*-torpedoes, which, when the can strikes a vessel, turn a stream of hydrogen on to a piece of spongy platinum and explode the charge; *horological* torpedoes, exploded by clock-work after the expiration of a given time.

The *Boule de Verdun* is the name given to a crawling torpedo which was to have been launched at Verdun with the purpose of destroying a bridge which the Prussians had thrown across the Meuse, about three miles below the city. It was a nearly spherical chamber, about 40 inches in diameter, and contained a clock-work mechanism for pulling the trigger of a double-barreled pistol which ignited the primary powder. It was based upon the principle that a spherical body of a weight slightly greater than the displaced water, and having its center of gravity and magnitude coincident, will seek and keep the deepest portion and current of the river. It was not used, as Verdun capitulated just before it was to be launched.

A drifting spar-torpedo intended to overcome obstructing chains or booms was invented by Lewis, of the British Royal

Fig. 6554.



Spar-Torpedo.

Engineers. It had a spar weighted to float nearly vertically, and when the upper end met with an obstruction, the lower end passed underneath, and, the weight being dropped by the action, the lower end, carrying the torpedo, rose rapidly and struck against the vessel's bottom.

b. Anchored torpedoes are attached to mooring piles or anchors. They are firmly connected to submerged structures, or by a cable or swaying boom which allows them some lateral play.

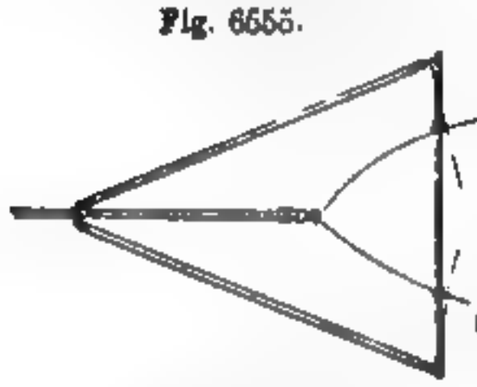
c. Spar-torpedoes. The spar-torpedo is carried on the end of a spar rigged overboard from the bows of a vessel, as seen in Figs. 6555 and 6556, or attached to the prow.

It is of sheet-copper with brazed joints. It has a sensitive primer, with a cylindro-conical head communicating with the magazine of the torpedo. The head is in contact with and protected from the water by a thin hemispherical cap of soft, well-annealed copper. Fig. 6554 shows the torpedo, the smaller figure being an enlarged view of the exploding arrangement.

The charge is usually fired by contact, but sometimes by electricity. The system was used in the extensive torpedo practice in Florida Bay, 1874.

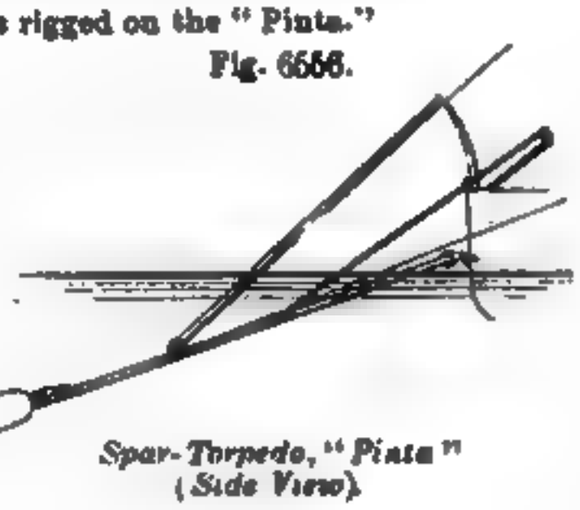
Figs. 6555, 6556, show it as rigged on the "Pinta."

Fig. 6555.



Spar-Torpedo Fittings, "Pinta" (Plan).

Fig. 6556.



Spar-Torpedo, "Pinta" (Side View).

The Wood and Lay spar torpedo was used in the United States Navy, notably by Lieutenant Cushing in destroying the Confederate ram "Albemarle" at Plymouth, N. C. in 1864. It was attached to a spar by means of the lug *b*; run beneath the enemy's vessel; detached from the spar by a device for that purpose; allowed to rise against the vessel by its flotative power, when the lanyard was withdrawn, allowing the ball *a* to fall upon the cap *c* and explode it and the charge.

The *otter*-torpedo, so called, is towed by a line from a boom rigged out athwart ship.

d. Maneuvered torpedo.

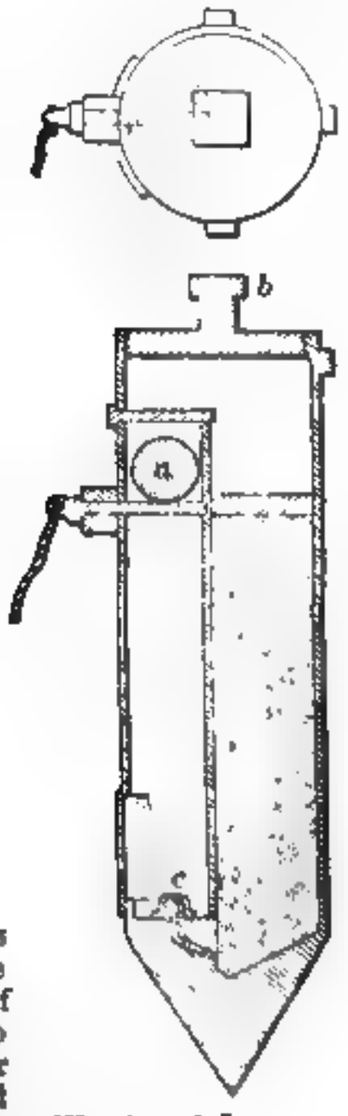
The *fish*-torpedo is so named from a certain resemblance in form, and from its having an independent and automatic swimming action after being launched in the direction of the object of attack.

It is also known as the *Whitehead* torpedo, and as the *Luppis-Whitehead* torpedo, from the names of two persons intimately concerned in its suggestion and invention.

The body of the *Ericsson* torpedo consists of a box of thin steel plates, 8 feet 6 inches long, 30 inches deep, and 20 inches wide. The explosive is placed at the bow. The propellers are two-bladed, 3 feet 2 inches in diameter, with a pitch of 5 feet. Both revolve around a common center in opposite directions. The motive power is a small double-cylinder oscillating-engine, driven by compressed air, which is supplied by a 25 horse-power steam-engine on shore, and transmitted through a tubular cable, connected just abaft the stern, as shown in Fig. 6558. The air-pressure also governs an equipoise rudder, secured under the bottom and near the bow. The steering is effected by applying the force of the air against the tiller on one side, counteracted by the tension of a spring on the opposite side.

The submersion is regulated by two horizontal rudders turning on a transverse axle which projects from each side near the bow. These wings or rudders are so contrived and governed that they keep the torpedo at a depth of from 7 feet to 12 feet below the surface, and are provided with automatic devices, so that the latter limit cannot be exceeded. In order to note the course of craft, a light

Fig 6557.

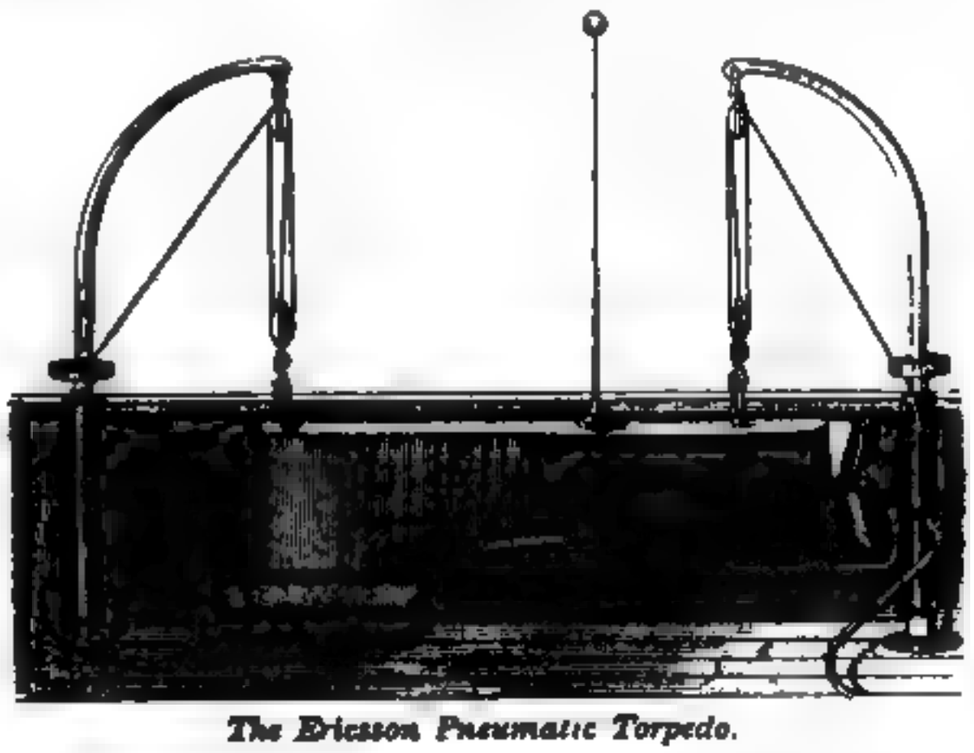


Wood and Lay Torpedo.

steel mast is secured to the deck. This is 12 feet in length, and terminates above in a wooden ball, the forward side of which is painted sea-green, so as not to be perceptible to the enemy, and the rear white, so as to be easily distinguished above the water by those dispatching the torpedo. Openings are made in the engine-compartment, through which the water enters, completely filling the interior space. The machinery is made of bronze with boxwood bearings, so that the water serves as a lubricant to every portion, thus doing away with stuffing-boxes at the rudders. The apparatus is launched overboard by means of swinging-davits, as shown in the figure. The bow-piece containing the charge is detachable.

The *Lay* torpedo used at Newport is a cigar-shaped vessel, 30 feet long and 8 feet wide, formed of water and air-tight iron plates, in three compartments. One of these is to contain the motive power, — compressed carbonic-acid gas. Another holds the machinery, which is controlled by an electric battery on shore by means of two wires, one of these governing the throttle and the other the steering-apparatus. In the third compartment is stored 500 pounds of powder or other explosive, and in the forward portion of the vessel explosive shells are also arranged to be fired by an electric spark passing through a third wire. These wires are embedded in a cable which is paid out as the vessel moves on. The shells are exploded without injury to the torpedo, but of course the explosion of the magazine causes its destruction.

Fig. 6558.



The Ericsson Pneumatic Torpedo.

Of late years the subject of harbor defense by means of torpedoes used offensively against an attacking fleet, has attracted great attention, and a naval torpedo-station has been established at Goat Island, Newport Harbor, for the purpose of instruction in their use and management on board vessels specially constructed for this object. See TORPEDO-BOAT.

No less than 18 United States vessels were de-

stroyed through the agency of torpedoes during the late war.

One was blown up, but not destroyed.

Of these were the monitors "Patapsco" and "Tecumseh," at Charleston and Mobile Bay respectively; the iron-clads "Cairo" and "Baron de Kalb," in the Yazoo River; the iron-clads "Milwaukee" and "Osage," in the Blakely River.

In the case of stationary submarine torpedoes, the operator must know the position of each, and be provided with means for determining when a vessel approaches within its range. For this purpose instruments for measuring angles are employed, or the torpedo itself is provided with devices for indicating the proximity of a ship.

Experiments are now being made at Portsmouth, England, on torpedoes of the latter class A network of these is connected by insulated wires with a galvanic battery on shore; the wires of one set conveying the message to the operator, and those of the other serving to explode any selected torpedo by touching a key.

In other cases the firing circuit is closed automatically by the action of the signaling apparatus. The firing is effected by a strand of platinum wire, made red hot by the passage of a current when the circuit is completed. These experiments are said to prove that comparatively large charges cannot be exploded without compromising other charges within their effective area. The question remains to be decided whether it will be more practically advantageous to employ comparatively small torpedoes placed closely together, or those of larger size placed at greater intervals apart.

Another English writer remarks that during the civil war in America, the Federal fleet was in no instance successful in passing a well-arranged system of fortifications where torpedoes were used, unless the forts were first reduced from the land; and in no instance did the navy fail to accomplish its object where torpedoes were not used.

As an instance of the fallibility of torpedoes, it was found after the capture of Charleston that the "Ironsides," the most powerful vessel in the Federal fleet, had lain for three months over a torpedo containing 3,000 pounds of powder. This was to have been exploded by electricity, but failed to go off.

An instance of the moral effect of torpedoes was shown in the Franco-German war, where the French navy was completely paralyzed by the presence of torpedoes thickly studded along the German coast, and not a single engagement between the fleet in German waters and the sea-coast defenses is recorded.

Published information on the subject of the torpedo trials may be found in the "Report of the Austrian Commission," 1868; "Army and Navy Journal," 1874; "Revue Maritime," September, 1872, January, 1873; Captain Harvey's "Treatise on the Management of the Sea-Torpedo," London, 1871; Sarrepont's "Les Torpilles," etc.

2. (*Military.*) A mine or countermine to destroy a work, a storming column, or a working party. In this sense a *petard* may be considered as a torpedo. Torpedoes for land defense are usually shells of small caliber, 6 and 12 pounders, provided with a percussion or friction device which causes an explosion when the ground over the torpedo is stepped on. Sometimes several are laid in a row, and a piece of board placed over them to increase the chances of explosion.

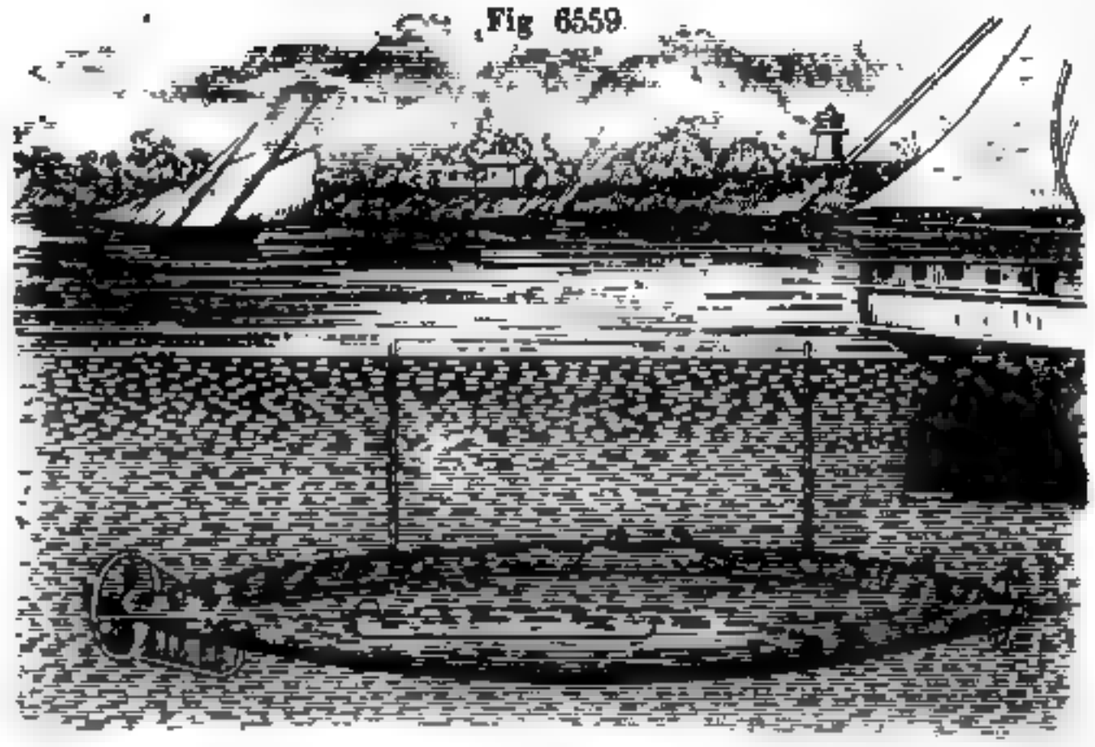
At Fort Fisher, larger torpedoes, connected in sets and designed to be fired by electricity, were arranged on the land face of the work. The wires leading to the majority of these were cut by fragments of shell during the bombardment, probably preventing considerable loss of life during the assault. Torpedoes buried in the ground and fired by a similar arrangement when trodden upon, and others connected by wires with electric batteries, were used in the defense of Sebastopol.

Fig. 6560 shows the northeast face of Fort Fisher, N. C., with the line of torpedoes, twenty-four in number, which were connected with the fort by three sets of double wires, each apparently intended to fire five or more torpedoes. The torpedoes were of three kinds: shells, 13″ diameter; boiler-iron cylinders, 13″ diameter and 18″ long; buoy-shaped sheet-iron cylinders of about the same capacity as the cylinders. Before the storming of the fort shells had cut a number of the wires leading from the work, saving the attacking party from much loss and demoralization.

Ground-torpedoes, buried beneath the surface to explode when trodden upon; *bridge*-torpedoes (Haupt's), to rend the timbers or arches of bridges in demolishing them; and *railway*-torpedoes, to blow up a track when a train passes, are all effective military devices.

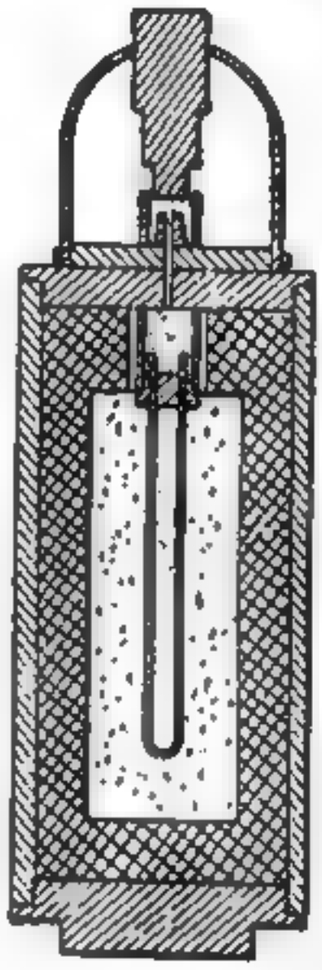
Some torpedoes of this kind are exploded by a time-fuse, which is let down with the instrument Others are exploded

Fig 6559



Lay-Torpedo

Fig 6561.



Roberts's Torpedo for Oil-Wells.

by a gunlock and wire from above, or by a plunger; but the best and most usual mode of igniting the charge seems to be an electric connection.

Fig 6561 illustrates a torpedo in which a powder-chamber is surrounded by nitro-glycerine, and a quick-match passes from the powder to the priming-chamber, which communicates through a tube with the fulminate, which is exploded by a hammer. An electric connection not only enables the operator to explode the charge at will, but other packing than water may be used to confine the explosion. A bag of flaxseed is often used for this purpose, which is lowered into the well dry, and, becoming saturated, swells and completely closes the aperture. The bag may be cut or torn open and withdrawn.

In an explosion in an oil-well in the petroleum region, where the boring was over 800 feet deep, two cartridges were prepared, the one 25 inches in length, the other 35 inches, and each 5 inches in diameter. These were connected by a short copper wire, 30 feet in length, so as to adjust the two charges immediately opposite to several mud-veins which were known to be that distance apart, the heaviest charge of 30 pounds nitro-glycerine being at the lower vein, 783 feet deep, the lighter charge at the upper vein. Twelve exploders were inserted in the largest cartridge, and eight in the other, forming a train of twenty exploders, which, by means of insulated wire, were connected about 250 feet from the well with an electric battery.

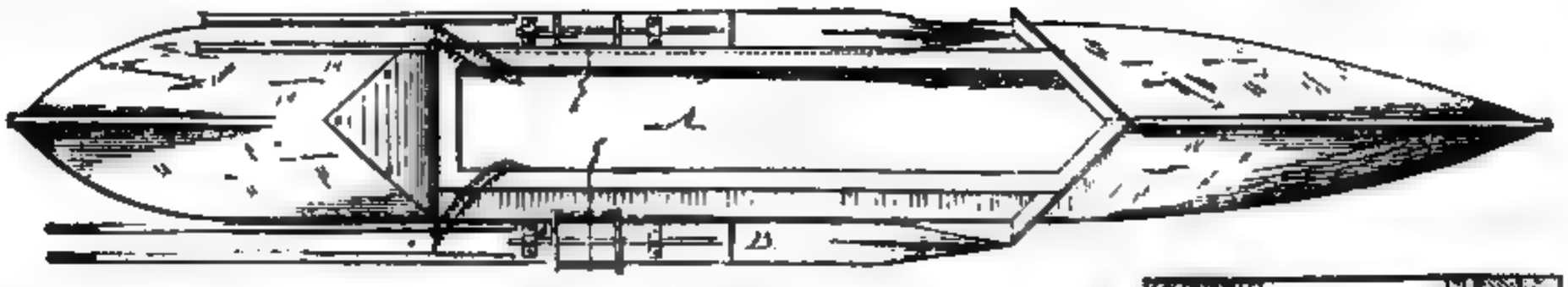
Everything being arranged, the order was given to fire. In an instant the discharge took place, and a report like a cannon fired from a distance, accompanied by a very perceptible vibration of the earth around, was noticed by those present. The operator and an assistant immediately pulled on the wire, thereby endeavoring to prevent entanglement. When about fifty feet of the wire had been drawn out a reaction ensued, dragging the parties who were pulling at the wire toward the well for a distance of ten feet, to their surprise and great wonderment; this arose from the column of water lifted by the explosion and its return and fall.

4. (*Railway.*) A cartridge placed on a rail to be exploded by a passing train, and thereby signal "caution" or "danger" to the engineer.

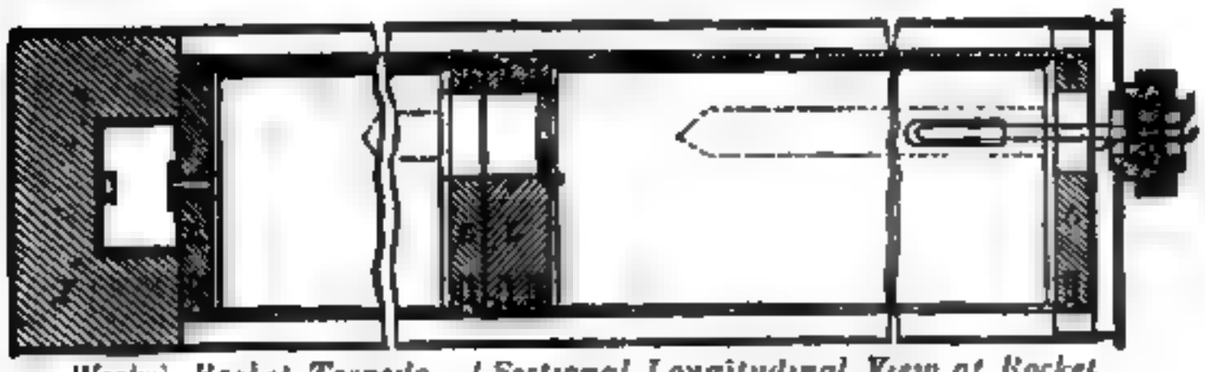
5. In the Rocky Mountain regions, some sporting gentry have adapted torpedoes to trout-fishing.

They take a cartridge of Giant powder, weighing about a quarter of a pound, insert into it a piece of fuse, properly capped, about six inches in length; then, lighting the fuse, the cartridge is thrown into any deep hole supposed to contain trout or any other fish. After the cartridge has been thrown into the water, smoke and bubbles of gas are seen to rise to the surface, then in a few moments comes the explosion, — a dull, heavy report. The surface of the water is seen to bulge up, and the ground can be felt to shake for fifteen to twenty feet back from the water

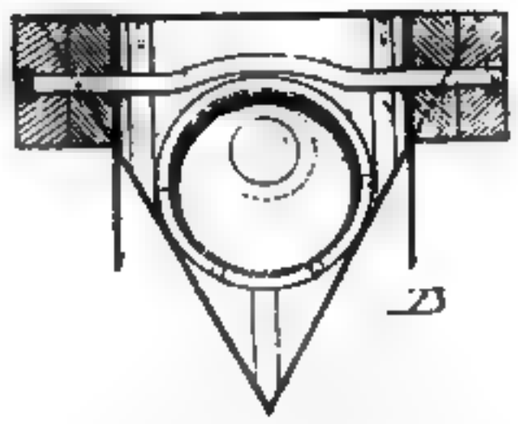
Immediately after the explosion, all the fish that happen to



Weeks' Rocket Torpedo.

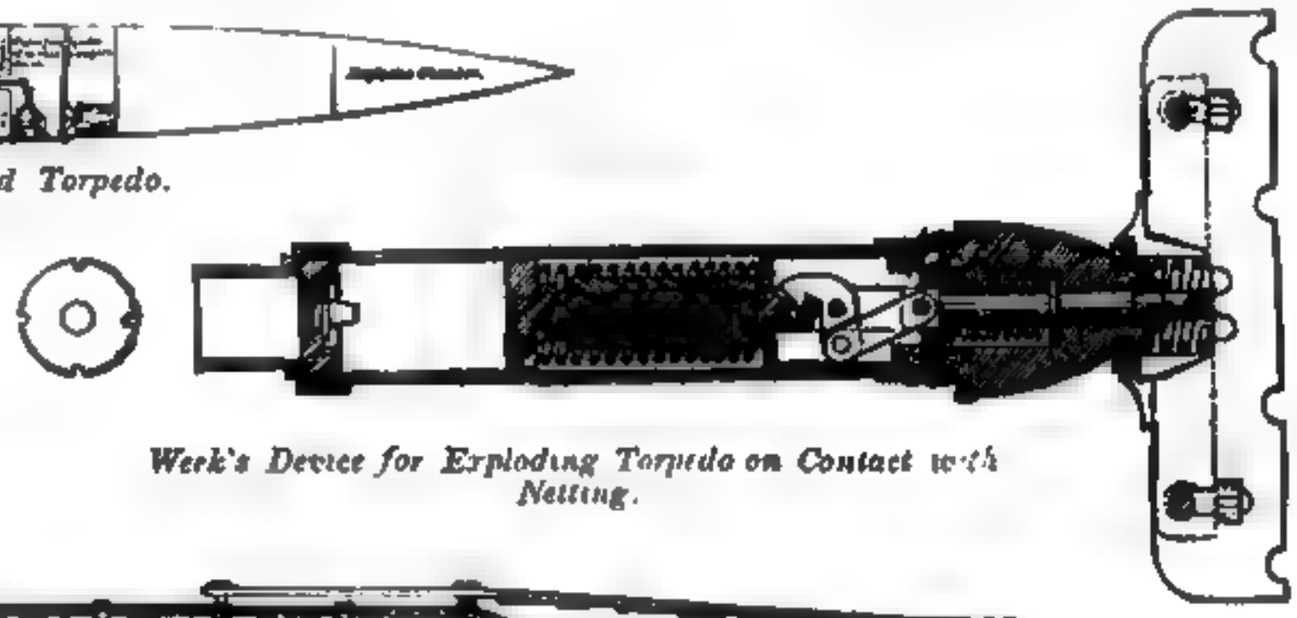


Weeks' Rocket Torpedo. (Sectional Longitudinal View of Rocket and Explosive Chambers.)

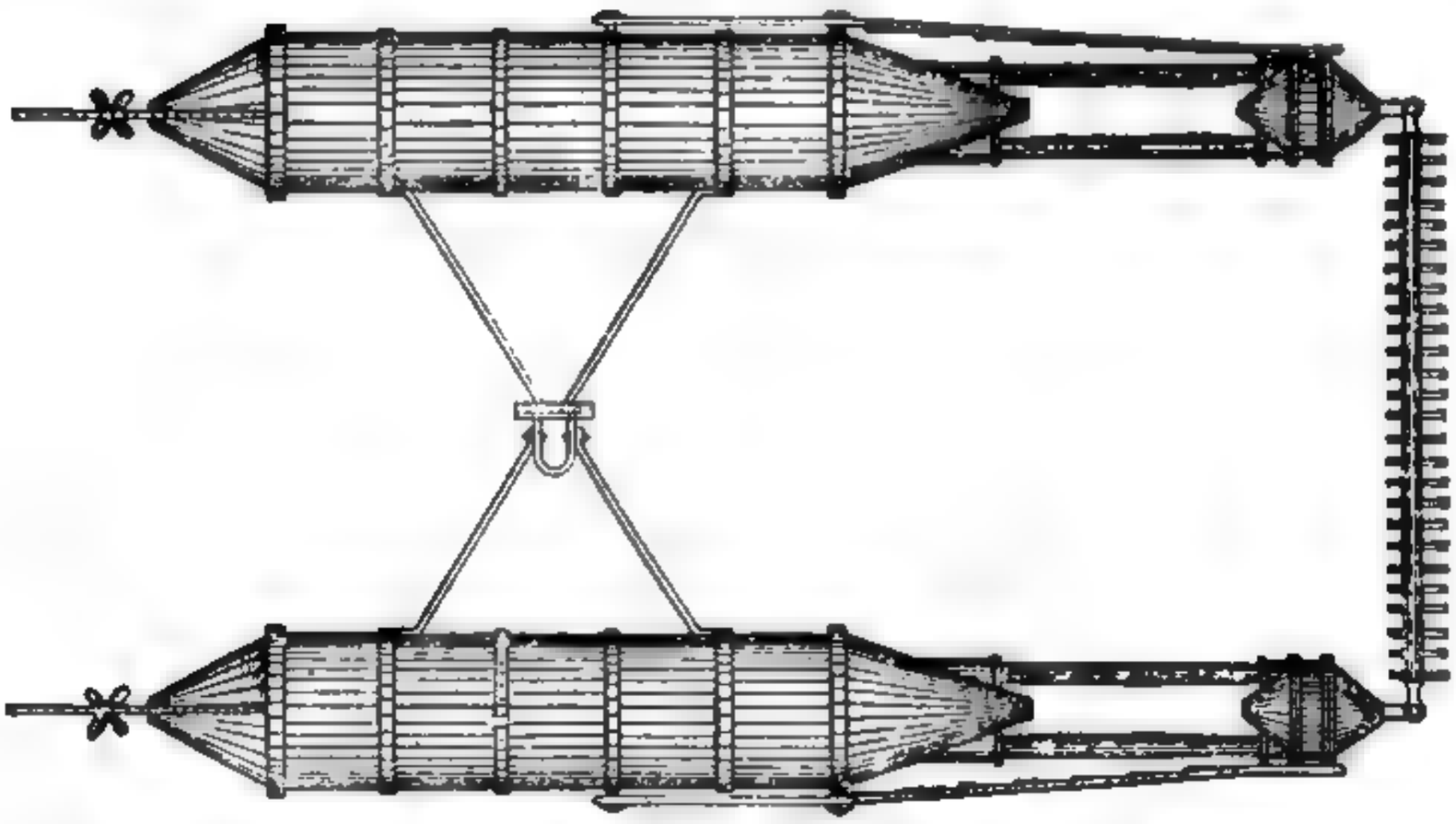


Weeks' Rocket Torpedo. (Sectional Transverse View)

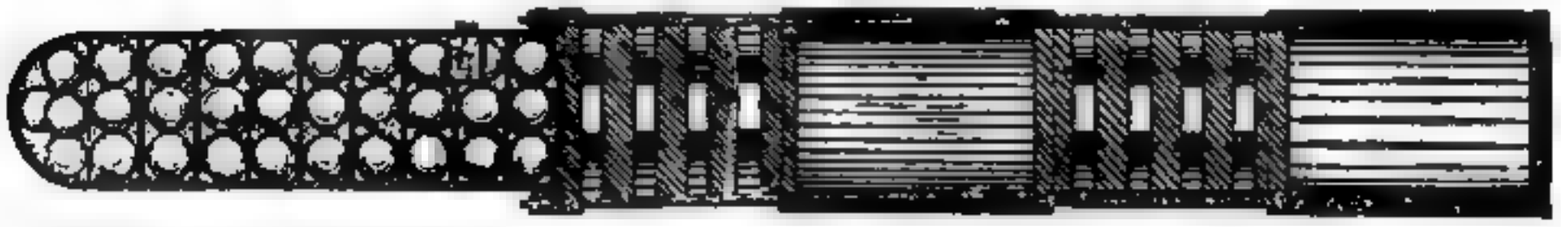
Whitehead Torpedo.



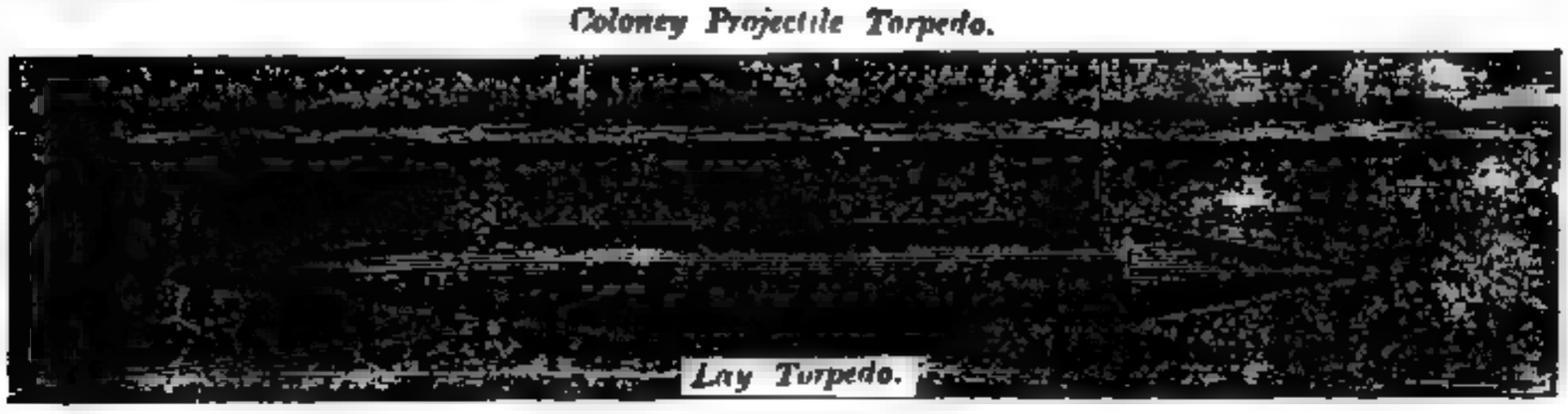
Week's Device for Exploding Torpedo on Contact with Netting.



Colonoy Torpedo.



Colonoy Projectile Torpedo.



Lay Torpedo.

be within a circle of twenty-five or thirty feet of the spot where the cartridge fell, come to the surface, either killed outright or so badly stunned that it is some minutes before they recover.

6. An explosive toy, consisting of a small quantity of fulminating-powder and fine gravel, wrapped in thin paper. It explodes with a sharp detonation when thrown upon any hard substance.

Tor-pe'do. Torpedoes have been divided into *defensive* and *offensive*, and the former into *electrical* and *mechanical*. (later entry)

I. DEFENSIVE:

1. The *electrical* includes those fired by the closing of a circuit, either by a party on the look-out or by contact of the vessel. They are defined as: *a*. "Electro-contact torpedoes"; *b*. "Torpedoes fired by observation."

a. The electro-contact torpedo is placed so that a vessel running against it will set in motion the electrical apparatus, but it can be rendered harmless as against a friendly vessel by an observer on shore, and as instantly restored to activity by the same agency.

A torpedo fired by contact can be much smaller in its charge than one fired by observation, as the proximity of the latter to the enemy can only be approximately determined, and it must be sufficiently powerful to be fatal to vessels within a considerable area.

b. In the torpedo fired by observation, charges of powder from 500 to 2,000 lbs. are used, to be fired when the vessel is over the spot where such is sunken, to be determined by means of collimators or telescopic observing areas.

The electric torpedo is not itself explosive, and a blow or a fall is harmless, except as it may injure the envelope and cause a leak.

It is preferably lighted by the platinum wire fuse, which is simple, safe, and certain, and can be tested electrically, both before and after it is placed in the torpedo, without the fear of explosion.

The charge may be gunpowder, gun cotton, dynamite, etc. The British prefer gun cotton; America and Sweden have experimented largely with dynamite; Prussia, during the war with France, 1870, 1871, used dualine, another nitro-glycerine preparation; Austria used gun cotton.

2. The *mechanical* includes those exploded by concussion.

ANCHORED TORPEDOES.—The *shell* torpedo is used for the defense of obstructions in rivers and harbors. It is bolted in an inclined position to a frame which is sunk upon the obstructions and loaded with stone.

The *arm* torpedo is of the buoyant anchored class. As the bottom or side of a ship comes in contact with one of the three arms which radiate like spokes at angles of 120° with each other, the hammer is unshipped, and the spring drives it upon the caps, which explode the charge.

The *percussion* torpedo has a loose lid which is displaced by the contact of the bottom or side of a vessel, and, falling off the torpedo magazine, pulls upon some wires which spring the hammers and explode the charge. This was one of the earliest in use during the late war, and continued to be employed to the last. It is understood to have done more execution than any other during the war.

The *submarine* torpedo consists of a water-tight tank of common powder, anchored by two chains below the surface of the water and exploded by electricity, contact, clock-work, or what not. The term is general rather than descriptive, in contradistinction to terrestrial or military torpedoes, and perhaps to those exposed on the ends of spars. See SPAR TORPEDO.

Into the center of the tank pass the terminals of two insulated copper wires, a fine platinum wire passing through a small cartridge of fine rifle powder in the middle of the charge.

Mechanical torpedoes of various forms are described on pp. 2599, 2600, "*Mech. Dict.*"

a. Drifting.
b. Anchored.
c. Boom or spar, Figs. 6554-6556.
d. Maneuvered.

II. OFFENSIVE:

These may be divided into—

1. The *fish* torpedo, of which Whitehead's (see Plate LII.) is the principal example.
2. Drifting torpedoes.
3. The sea torpedo.
4. Torpedo boats.

1. The fish torpedo has a steel or iron fish-like case: the front fitted with a percussion fuse communicating with the charge. The stern of the Whitehead torpedo has machinery for working a screw by compressed air, which is in a reservoir amidships. It is launched from shore or from a ship, and pursues its course under water.

The Lay torpedo (see Plate LII.), p. 2599, "*Mech. Dict.*," uses condensed carbonic acid gas. A cable containing the electric wires pays out as the torpedo proceeds; two of these are for governing the machinery and the third for exploding the charge.

Col. Lay's torpedoes are still extensively used in Europe, especially in Russia, and his star torpedoes in the Russian navy; and two of his torpedo boats are owned by the United States government. This boat, as recently improved, can be controlled at a distance of more than a mile and a half.

The Ericsson torpedo is launched from a vessel, and has an india-rubber tube which pays out and conveys compressed air, which furnishes the motive power. Fig. 6558, "*Mech. Dict.*," described on page 2599.

2. Drifting torpedoes have cases of various kinds, and are abandoned to drift in a current or with the tide.

3. The sea torpedo is used in action, and is a case maneuvered by lines from the yards of the vessel.

4. Torpedo boats are of several kinds (see p. 2601, "*Mech. Dict.*"), and either carry the torpedo on a spar or a projection from the stern, or are arranged for launching fish torpedoes.

The *turtle* torpedo is so named from its resemblance to that animal, and is placed to prevent raking or grappling for a moored boom torpedo, being connected with the latter by a rope 130′ or 140′ long.

The Whitehead fish torpedo is a spindle of revolution, made of iron and steel, about 14′ long, and having a diameter of 14″, and carries a charge of 20 lbs. of dynamite. It is driven by a propeller and a compressed-air engine, the air being contained in a reservoir. A rudder regulates the depth and the direction, being adjustable so as to direct it along any curve required. The after half has projecting longitudinal ribs, which are extended aft to the ring which surrounds the propeller, and afford rests for the torpedo in launching. The bow, which contains the explosive, may be separated from the body of the torpedo and be stowed in a magazine. The extreme point forward has an arrow-head to stick into the side of a wooden vessel.

The results attained have been speeds of from 10½ to 7½ knots per hour for distances of from 720′ to 4,500′; but more lately one has been made to run 600′ at the rate of 17 knots, or a mile at the rate of 10 knots. This trial was witnessed by some U. S. officers at Fiume, and is reported in the "*Army and Navy Journal*" of November 28, 1874. It is described in the "*Army and Navy Journal*" as cigar-shaped, made of ⅜″ inch steel, and 15′ long, 15″ in diameter. It has a six-bladed screw with expanding pitch, and four T-iron angle pieces running three fifths of its length. A pistol at the bow is exploded by concussion, and in addition there are three triggers projecting from the bow, which may explode the charge by contact with a vessel. This torpedo had no apparent steering apparatus, traveling only in the direction given to it at starting by the adjustment of the rudder. The pressure in the reservoir is 1,000 pounds per square foot.

The action of current is taken into consideration in launching, as well as the rate of motion of a vessel at which it may be launched. It can be launched by projection from a tube by compressed air, or by hand by simply starting.

Mr. H. F. Hicks has designed a gun that is used, like that of Ericsson, to propel torpedoes under water, but the motive power is steam instead of gunpowder. The gun has a number of steam chambers connected with the bore, so as to use steam pressure successively and act on the principle of accelerated velocity, on the plan of Haskel's gun.

Myron Colouey, of St. Louis, has a system of floating torpedoes, with magnets secured to them (see Plate LII.). The magnets are intended to securely attach the torpedoes to iron vessels before exploding.

The torpedo invented by Asa Weeks (see Plate LII.) is believed to be the most powerful and destructive rocket torpedo yet produced. The torpedo proper is a triangular float, having two side wings extending astern, where they are provided with keels or cut-waters. The wings serve to maintain the balance of the torpedo, as it grows lighter from the combustion of the rocket composition, and the cut-waters serve as guiding rudders. The bursting charge of dynamite is in the front compartment of the torpedo, and is exploded by a percussion primer on contact with an obstacle, or is blown up by fire from the rocket charge after the expiration of a suitable interval.

The torpedo is slung at the davits of a steam launch made expressly for the purpose. The prow of the torpedo rises a little above the general surface line to prevent the tendency to run under when striking a wave. The rocket is carried in cylindrical chambers, and the powder is cored out eccentrically to the inclosing casing. This arrangement of the powder secures a nearly uniform combustion. The combustion chambers are surrounded by some refractory substance to prevent injury to the float and danger to the bursting charge. The rocket charge is ignited preferably by an electric ignitor, and the torpedo detaches itself from the davits,

being hung thereto by a loop and pin. The rocket runs on the surface of the water, and can be made to travel at the rate of 100′ per second for 1,500′. The cost of a rocket carrying 50 lbs. of dynamite has been reduced below $500.

This torpedo has been adopted by the United States government after full investigation of its merits.

Mr Weeks is the inventor of a star torpedo operated from the deck of a fast steam launch. He has also a floating or drifting torpedo that is detached from the float when it encounters an obstruction and explodes after sinking a few feet. It is intended to be set adrift in rivers and tideways where the current sets in the direction of a hostile fleet.

Col. Mallory's rocket torpedo has an ingenious arrangement of the rocket charge to secure uniform combustion. The charge of slow powder is made up into a large number of small cartridges, placed in holes radiating from a central chamber in a cylinder of fire clay. The cartridges all burn at once, and as only the end of each cartridge is presented to the flame the extent of the burning surface remains the same, and the decrease in weight by burning is regular. The air is permitted to escape at a determined rate from the air vessel that surrounds the torpedo, and so the loss in flotation equalizes the loss in weight due to combustion, the torpedo thus being advanced in a predetermined depth under the surface of the water.

The torpedo-boat invented by Bushnell, of Conn., in 1777, proved the feasibility of this style of warfare by blowing up a British tender in the harbor of New London, and but for the awkwardness of the person in the boat, would have blown up the "Eagle," a British sixty-four gun ship in New York harbor. This same person, in the same year, set a squadron of kegs afloat in the Delaware river, arranged to explode upon coming in contact with anything. They were set adrift too high up, so that they approached in the daytime. One boat was blown up. The British from the shore fired on them, which gave rise to the famous Battle of the Kegs, of which so much sport was made by our revolutionary writers.

The usual arrangement of booms, spars, and nettings for resisting the attacks of torpedo boats having been found ineffectual in the British navy, a magneto-electric light, contrived by Mr. Wilde, of Manchester, for the purpose of detecting the approach of a torpedo boat at night, has been tested. The carbon points and lens are arranged in a box which has vertical and horizontal adjustments permitting the beam of light to be rapidly directed to any point of the horizon and upon any object within the limit of its vertical range. Two steam pinnaces fitted with torpedo arrangement were employed to make a sham attack upon the "Comet," which was provided with one of these machines, but were in each instance discovered before approaching within a mile, the direction of the proposed attack being previously unknown.

Tor-pe'do-an'chor. An anchor or fastening to hold a submarine torpedo to its selected bed. A serviceable form is that of a ship's anchor, to which the torpedo is attached by a chain with a universal joint.

Tor-pe'do-boat. A vessel carrying a *torpedo*, and either exploding it against the side of another vessel beneath the water-line, or launching it against the enemy's vessel when it may be trusted to reach its destination by the force of the impulse, or by a motor on board.

The *torpedoes* are carried on the ends of spars rigged forward, or are towed by booms, or are cigar-shaped vessels known as *fish*-torpedoes, which may be considered self-navigated projectiles. See TORPEDO.

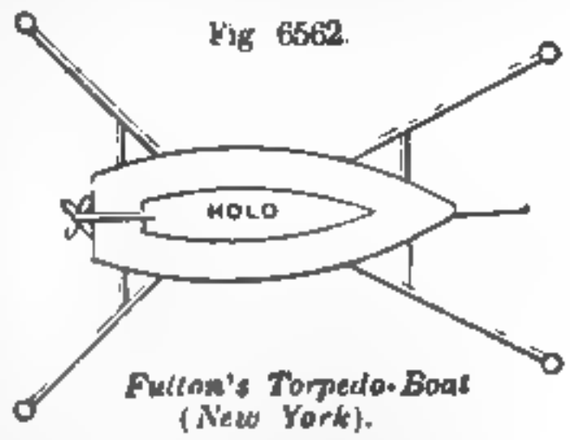
The first *torpedo*-vessel was perhaps the "American Turtle" of David Bushnell, of Connecticut, in 1776. His was a submarine vessel having a torpedo in tow.

It was composed of two shells of sufficient capacity, when joined together and made water-tight, to contain the operator, together with sufficient air to enable him to remain under water for half an hour. He caused the boat to rise or sink by pumping the water from or allowing it to enter a chamber beneath him, at the same time lowering or raising a block of 200 pounds of lead which might be made to touch bottom. He propelled the boat by means of an oar, from a compartment in the fore part, and at its stern a magazine containing powder was attached; this was fired by a lock operated by clock-work in the magazine, which was set in motion at the time of its detachment from the boat, and was calculated to run a sufficient time to allow the operator to reach a place of safety previous to the explosion. With this apparatus he succeeded in frightening the crew of the British 64-gun ship "Eagle," in New York Harbor, and afterward blew up a schooner at New London.

The celebrated Fulton, between the years 1800 and 1807, devoted considerable attention to torpedoes and torpedo-boats, and in 1810 published a work on the subject.

While in France he constructed a boat which, when at the surface, was propelled by a sail, and resembled an ordinary boat; the mast could be struck, and the boat, with its contents, submerged to the depth of several fathoms, and propelled by machinery, at the rate of about four miles an hour, in any direction desired. This invention at first met the approval of Napoleon, who, however, afterward appears either to have lost faith or grown tired of it, as the boat was never brought to any further practical test.

Fig 6562.



Fulton's Torpedo-Boat (New York).

After the return of Fulton to America, he continued the experiments, without, however, much success. Fig 6562 shows a boat he devised of 300 tons burden, with sides 6 feet thick, designed to be cannon-proof, and musket-proof decks 6 inches thick. She was to be propelled by a scull-wheel, and was intended to carry two torpedoes on each side, fixed on the ends of spars 96 feet long, supported by guys from the mast-head.

During the late civil war a number of these submarine "infernal machines" were constructed by each party.

The first of these attacks was made off Charleston, against the United States war-vessel "Ironsides," by a cigar-shaped boat, under the command of Lieutenant Cassell, with a crew of three men, carrying a torpedo containing 60 pounds of powder at the end of a spar. Not knowing the action of the explosion, and thinking that their boat would probably be sunk by it, her crew jumped overboard before ramming. The explosion, though severe, failed to make any hole in the bottom of the "Ironsides"; the boat was also uninjured, and was found drifting, half full of water, by her engineer, who climbed into her, made up his fires, and steamed back safely to Charleston.

The submarine torpedo-boat which sunk the United States steamer "Housatonic," of 1 240 tons, and 13 guns, off Charleston, the largest vessel thus destroyed during the war, was 35 feet long, made of boiler-iron, and could be submerged to any desired depth, or propelled upon the surface. She was designed to pass under the bottom of a vessel lying at anchor, and drag a floating torpedo, which should explode on striking the vessel, and could remain submerged for half an hour without inconvenience to her crew, which consisted of nine men, eight to work the propeller and one to steer. The following is her history in brief: She was first sunk by the swell of a passing steamer, drowning all hands, except her commander. After being raised she again capsized and sunk, her commander and two others alone escaping. Being again raised, she made an experimental trip, under one of her constructors, and, while submerged to a great depth, became unmanageable from some

Fig 6563.

Porter Torpedo-Boat.

unknown cause, and remained for many days, with her crew of nine dead men, at the bottom of Cooper River. Her last achievement was the destruction of the "Housatonic," when she and her crew disappeared forever from all human knowledge.

Of late, however, it is not considered as an absolute prerequisite to an efficient torpedo-boat that she should be capable of being entirely submerged when making an attack. Admiral Porter's system provides vessels of sufficient power to resist the fire of an enemy, and attack openly when necessary. See Fig 6563.

The destruction of the rebel ram "Albemarle," at Plymouth, N. C., October 27, 1864, was accomplished by the use of one of Wood and Lay's torpedoes (see TORPEDO, Fig 6557), modified for use by a ship's launch.

The steam-launch was run up under cover of night, and succeeded in eluding the picket-boats of the enemy. The "Albemarle" was discovered lying fast to the wharf, with logs around her, about 30 feet from her side. As the launch approached she was fired on from the shore, but continued her

course straight for the ram. Striking the logs, they were driven inward some feet. "The torpedo-boom was then lowered," says Lieutenant Cushing, "and, by a vigorous pull, I succeeded in driving the torpedo under the overhang, and exploding it at the same time the 'Albemarle's' gun was fired. A shot seemed to go crashing through my boat, and a dense mass of water rushed in from the torpedo, filling the launch and completely disabling her." The "Albemarle" sunk at her moorings. Lieutenant Cushing and one of his crew escaped by swimming

Just before the close of the war an attack was made, in the James River, on the merchant-vessels which had brought supplies to Grant's army by the Confederate fleet of three iron-clad rams and seven gunboats, all armed with torpedoes, fixed on the ends of spars, 30 or 40 feet long, which projected from their bows, and could be raised or lowered by a tackle. This fleet was stopped by a boom, and two of the iron-clads got aground, where they remained all night, under fire from the banks; but although their torpedoes were completely riddled with rifle-shot, not one was exploded by the striking of the fuses.

The Porter torpedo (Fig 6663) is an iron vessel 174 feet long, 28 feet broad, and 13 feet deep. It consists of two hulls of equal strength, one within the other. A person may pass between the inner and the outer vessel from stem to stern. The compartments are water-tight, so that if the vessel sustains any injury from grounding or from other cause, only a small part will be filled with water. When in fighting trim, the compartments have water let in so as to submerge the vessel with the exception of about three feet. The masts are also lowered, and nothing rises above the deck save the short smoke-stack, the pilot-house, and the heavy forecastle gun. It has a "ram" snout from which the shell may be thrust out on a long staff. After this explodes, the enemy's ship may receive a thrust from the ram and a shell from the gun. If it be desired to deliver a broadside attack, there are two apertures on each side of the vessel, through which torpedoes may be thrust by means of poles.

Tor-pe'do-boom. A spar bearing a torpedo on its upper end, the lower end swiveled and anchored to the bottom of the channel.

The boom sways back and forth, and is difficult to catch by any form of drag or grapple.

Tor-pe'do-catch'er. A forked spar or boom extending under water, ahead of a vessel, to displace or explode torpedoes.

Tor-pe'do-drag. A cable bearing grappling-hooks to catch torpedoes. The ends of the cable are generally carried in boats some distance apart, which are propelled up and down the channel.

Sometimes the drag-rope is thrown ahead of a vessel by a shell from a small mortar, and drawn in by the windlass.

Tor-pe'do-fuse. One adapted for torpedo service, and classed: *percussion*, *friction*, *chemical*, *electric*.

Tor-pe'do-raft. A raft pushed ahead of a vessel, with hooks or grapples underneath, to clear the channel of torpedoes.

The raft sometimes carries its own torpedo in front, to blow up obstructions or hostile shipping.

Tor-pe'do-ram. One which carries an explosive in the ram to supplement the force of the collision.

Tri'dent. 1. A three-pronged spear formerly used by the *retiarius* in the gladiatorial contests.

2. A three-pronged fish-spear.

Trig'ger. 1. (*Fire-arms.*) A catch which, being retracted, liberates the hammer of a gun-lock. See illustrations, Plates XVII., XVIII.

A *hair-trigger* is a duplication of parts; the supplementary trigger is released with very slight force, and liberates a spring which instantly retracts the main trigger from the *sear* of the hammer.

Trow'el-bay'o-net. A bayonet resembling a mason's trowel, used as a weapon, and as a light intrenching-tool, or as a hatchet when detached from the rifle. Invented by Lieutenant-Colonel E. Rice, U. S. A.

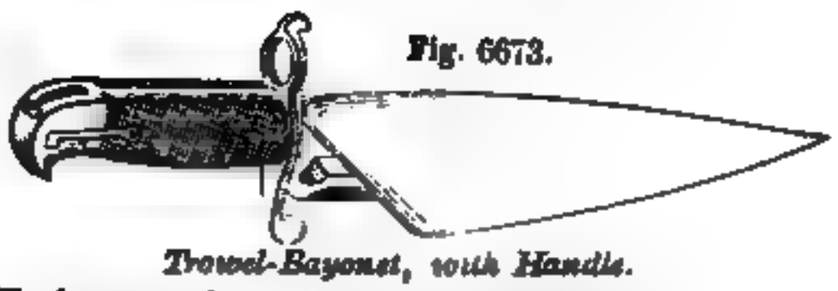


Fig. 6673.

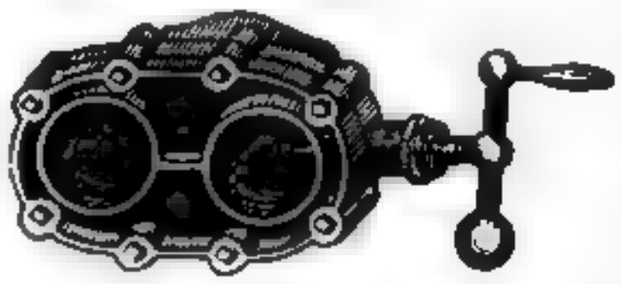
Trowel-Bayonet, with Handle.

The bayonet shown in the cut is fastened to the rifle by a spring clamp. It weighs about 15 ounces. As an intrenching-tool it has been found very useful in light soils, and 10,000 bayonets of this pattern are now making at the Springfield Armory, to be placed in the hands of troops in the field.

Trun'dle-shot. (*Projectile.*) A bar of iron, 12 or 18 inches long, sharpened at both ends, and a ball of lead near each end. It upsets during its flight.

Twist. 1. (*Small-arms.*) A mode of construction of gun-barrels in which the iron, in the form of a ribbon, is heated and coiled spirally around a mandrel. The spiral is then raised to a welding heat and dropped upon an iron rod, which is *jumped*; that is, struck forcibly and vertically upon an anvil, which causes the edges of the spiral to adhere. The welding is finished on an anvil, the mandrel retaining its position inside.

Fig. 6835.



Twin-Valve.

The ribbon of iron is several yards long and about half an inch wide, varying in thickness from the thick or breech end of the barrel to the thin or muzzle end.

Fig 6836.

Twisted Barrel.

Various kinds of ribbons are made. Those from horseshoe nails and steel are called *stub-twist*. A certain laminated iron and steel is known as *wire-twist*. A laminated iron and mild steel, laid parallel in ribbons, welded, then twisted at one end while the other is held in a vise, combined in a fagot with another or others twisted in a diverse direction, rolled, and drawn into ribbons, is a *Damascus-twist*. See GUN-BARREL.

2. (*Guns and Ordnance.*) The spiral in the bore of a rifled gun. It is spoken of as a ¾ twist, etc., as it completes that much, more or less, of a revolution in the length of the barrel.

An *increase* or *gaining* twist is one in which the spiral inclination of the grooves becomes more rapid toward the muzzle. Invented by Tamisier.

Another mode of designating the twist is in the length required to complete a revolution, which is usually considerably in excess of the length of the barrel.

V — Z

Ve-lo-cim'e-ter. An apparatus for measuring the velocity of projectiles in guns.

The methods that have been tried for ascertaining the law of motion of a projectile in the bore of a gun (with a view to finding the law of pressures developed) give only a small number of points of the curve of spaces traversed in given times, and they involve perforation or other injury to the walls of the gun, so that they are applicable only to large pieces.

A new and ingenious method, advantageous in these respects, has been contrived by M. Seibert. In the axis of a cylindrical hollow projectile he fixes a metallic rod of square section, which serves as guide to a movable mass. This mass, or runner, carries a small tuning-fork, the prongs of which terminate in two small metallic feathers, which make undulatory traces on one of the faces of the rod (blackened for this purpose with smoke) as the runner is displaced along the rod. The runner, it will be understood, is situated

at first in the front part of the projectile, and while the latter is driven forward remains in place, the rod of the projectile moving through it. The escape of a small wedge between the prongs of the fork at the moment of commencing motion sets the fork in vibration. It can be easily shown that, owing to the very high speed imparted to the projectile, the displacement in space of the inert mass, through friction and passive resistances, which tend to carry it forward with the projectile, is such as may be quite neglected. So that the relative motion of the mass recorded by the tuning-fork may be considered exactly equal and opposite to the motion of the projectile. A study of the curves produced guide to the laws of the motion and of the pressures developed by the charge. Evidently the motion of a projectile, as it buries itself in sand or other resistant medium, may be similarly determined.

Also used to measure the recoil of guns during the first instant after the charge is fired.

Ver-nier' Scale Sight. (*Rifle.*) A hind sight with a vernier scale for accurate adjustment. The peep-sight is elevated or depressed by a screw; the scale on the bar of the sight being slotted.

Vig'o-rite. A nitro-glycerine explosive, manufactured at Marquette.

Bjorkmann, of Stockholm, Sweden, gives the following recipe for the manufacture of the new explosive, vigorite: Mix in a wooden or rubber vessel 5 to 20 parts of sugar or molasses, 25 to 30 parts of nitric acid, and 50 to 75 parts of sulphuric acid. 25 to 50 parts of this mixture, called nitroline, are mixed with 15 to 35 parts of nitrate of potash and 15 to 35 parts of cellulose.

Wad. 1. (*Fire-arms.*) The wad of a gun is intended to hold the charge in position at the rear of the chamber, or to prevent windage. In small-arms it is usually a disk of felt, punched by a circular wad-cutter. An old felt hat furnishes excellent wads. Plugs of paper, oakum, or cardboard are also used.

2. (*Ordnance.*) Wads for ordnance are of four kinds.

Junk wads: made of old rope
Grommet wads: made of cordage, in the form of a ring.
Papier-maché wads: small disks for closing the fuse-holes of common shells and the louling-holes of diaphragm shells.
Coal-dust wads: serge bags filled with coal-dust, placed inside the 5-pound cartridges for 8-inch guns, to fill up the chamber.

Wad-punch. A tubular steel punch used for cutting gun-wads, etc. A similar punch is used by leather-workers and others.

Wheel-lock. 1. (*Fire-arms.*) A form of lock for fire-arms which superseded the old matchlock, whereby the piece was touched off by a match or port-fire.

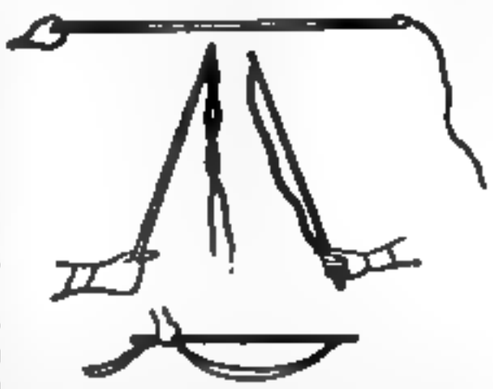
The wheel-lock was invented in Italy early in the sixteenth century; it was moved by a chain and wound up like a watch to prepare it for use. The wheel, originally, was not fixed in the gun, but was fitted in a groove when ready for firing; at other times being carried in a bag. It consisted of a furrowed wheel of steel, whose friction against a piece of sulphuret of iron was made to communicate fire by sparks to the priming. See GUN-LOCK.

Whip. 1. (*Saddlery.*) An instrument used for driving horses and other animals, or for correction; commonly consisting of a handle, a thong of plaited leather, and a lash of plaited hemp or other fiber. Frequently, however, the handle and thong are in one, forming a tapering flexible rod; riding-whips are made in this way.

The device is very ancient, being referred to in Proverbs xxvi. 3, and Nahum iii. 2. "The noise of a whip, and the noise of the rattling of the wheels, and of the prancing horses, and of the jumping chariots." It was in use, however, long before this.

The Egyptian whip consisted of a short, round wooden handle, and a single or double thong about 2 feet in length, twisted or plaited. A loop was attached, so that it could be swung from the left wrist while the archer was using his bow. Short, knotted whips, much resembling our riding-whips and the postilions' whips of the last and the early part of the present century, are also shown in the paintings of Thebes.

Fig. 7195.



Egyptian Whips (from Thebes).

The whips of the ancients generally had knots or bronze or leaden (*plumbatum*) balls on the lashes to render them more severe. The priests of Cybele punished themselves with whips on whose lashes were the *astragali* bones of kids. Greek whips were of leathern thongs, twisted cords of hog's bristles, or sinews of oxen. The *scorpio* was a whip with iron spurs. The Anglo-Saxon whip for prisoners was three-lashed. Switches were used for soldiers.

Eel-skins were used to flog school-boys by the Romans and Anglo-Saxons.

The ancient Scythian whip resembled the *nogaik* of the modern Cossacks. It had a short handle and a single lash, with a round flat piece of leather at the end. The taskmasters of Egypt and Persia hurried up their workmen with whips. Xerxes lashed the laborers who dug the canal across the isthmus of Athos; and his soldiers were hurried by whips across the Hellespont bridge, during the 7 days and nights which they occupied in crossing between Abydos and a rocky point in the Hellespontine Chersonese. The bridge was about 1½ miles long.

The artillery-driver's whip has an interior stock of raw hide covered with India-rubber cloth, over which is sewed an outer covering of leather. A loop is attached at the but for suspension. A lash of thread is attached to the small end.

Fancy whips are made with handles composed of a central core of whalebone stiffened and filled out with rattan; this is inclosed in rubber cloth and covered with rubber cement, over which strands of cotton, silk, or gut are braided by machinery.

Whip Ma'king.

The main items of expense in whip making material are rattan and whalebone. The rattan is imported from Batavia and China. The qualities which are too soft, or otherwise unfit for use in whips, are sorted out and sold to the basket-makers. The fine strips which make up the stock of a whip are split out first by hand, and afterwards worked down by drawing them through a shave, which can be gaged. The whalebone is already split when imported.

The main part of most whips is composed of nine pieces. The whalebone is in the center, surrounded by the thin strips of rattan, and secured in place by glue. This compound stock is dipped in glue so that every part is permeated by it, and then run through a machine, which winds it with a strong thread from end to end. It is again wound with rope, so that it cannot warp out of shape, and left to dry. A peculiar turning lathe gives a smooth finish and even taper from butt to tip.

The thread covers are plaited on to the stocks by machines, which are wonders of ingenuity; some carrying as many as 24 spools. Some of the better grades of whips have this cover made of fine gut, prepared from sheep entrails. Sometimes a portion is worked on by hand, and fancy designs in colors, or the owner's name is introduced. A great variety of sticks is used for the stiff portion of the stock, many of them being very handsome, and include the holly and other ornamental woods. The Malacca cane, which grows in the Dutch East Indies, and is imported, is also used largely.

Fine lashes for stage drivers, teamsters, or tandem whips are plaited out of the best California deer skin. They contain from 4 to 24 strands, and are from 4′ to 16′ long. Horse hide answers for the cheaper grades used by cartmen and others.

Plaiting lashes well can be done only by careful and experienced hands and is all piece-work. Much of it is given out to be done at the homes of the operatives.

Whit'worth Gun. (*Ordnance.*) A kind of rifle invented by Mr. Whitworth of Manchester, England. The bore is hexagonal in section and has a very rapid twist. The projectiles are very elongated in form and adapted to closely fit the bore, studs and expansible rings being dispensed with. Cannon and small arms, both muzzle and breech-loading, are constructed on this principle, the breech-loading form, however, being generally adopted.

Fig. 7212 illustrates one of the latest of Mr. Whitworth's improvements. The gun is of cast-steel, compressed while still in a fluid state, whereby the tensile strength is greatly increased.

A is a vertical, *B* a horizontal section, *C D* end elevations showing the breech in open and closed positions respectively.

The barrel *a* is strengthened by a reinforce band *b*; in large guns more than one of these bands may be employed. The central part of the rear end of the reinforce is cut away, forming a groove in which the breech-block *c* slides. The faces of this opening have a series of parallel grooves *d*, adapted to receive a corresponding series of teeth *e e* on the breech-block, and by which it is held when pushed home in position for firing. These grooves are very slightly inclined to the axis of the bore, so that as the breech-block is moved into this position it is drawn up close to the face of the breech. The movement is effected by a lever *f*, connected by interlocking projections with a pinion *g*, which gears with a rack *h* at the bottom of the breech-opening; a pawl *i* dropping into a notch in the pinion *g* serves to hold it in place, but may be lifted to permit its removal. The cartridge-chamber *k* is of larger diameter than

Whitworth Gun.

the bore of the gun, and is somewhat enlarged at its base; to facilitate the insertion of the cartridge a groove *l* or a circular opening, corresponding in diameter to the cartridge, is also made in the breech-block; this opening receives a shot-guide *m* having an aperture through which the projectile is passed in loading, and by which it is directed into the bore; when in place this guide is removed and the cartridge inserted; to facilitate this the rear end of the bore is very slightly enlarged. By turning the lever *f* the breech-block is then slid into firing position and the gun is ready for discharge. The interlocking projections on the lever and the pinion *g* having a certain amount of play allow the lever to act as a hammer to more effectually start the breech-block at the commencement of this and of the return movement. A steel gas-check *n* is provided to prevent escape of gas at the breech. It will be observed that the grooves *d* are undercut to prevent any tendency on the threads of the breech-block to separate the two parts of the reinforce-band which serve as guides. *o* is the upper end of the elevating screw-link.

The nine-pounder field-gun on this plan is made from a solid ingot of steel, no reinforce-band being employed. Its length is 6 feet 2 inches; weight, 8¼ cwt.; external diameter at the breech, 10½ inches; muzzle, 4½ inches; diameter of major axis of bore, 2.72 inches; of minor axis, 2 47 inches; charge of powder, 2½ pounds.

The rifling has a twist of 1 in 55 calibers, and the ordinary projectiles are 3½ diameters in length, and are fired as cast, without being trimmed up. The carriage is also of steel, weighing 10 cwt.

Steel shot having their sides smoothly dressed up are frequently employed with the Whitworth gun, which is peculiarly adapted for firing solid shot, though hollow projectiles are also used

Small arms rifled on this plan are better suited for hard metal than leaden projectiles; with the former great penetration and accuracy are attainable.

Wip'er. 1. (*Valve Motion.*) A cam which projects from a horizontal shaft and acts periodically upon a toe whose elevation lifts the valve-rod and puppet-valve.

The *wiper* has usually a rotary reciprocation: when the rotary motion is continuous, it becomes a wiper-wheel, which may have a number of cams acting consecutively in the course of a revolution.

Fig 7260.
Wiper and Toe.

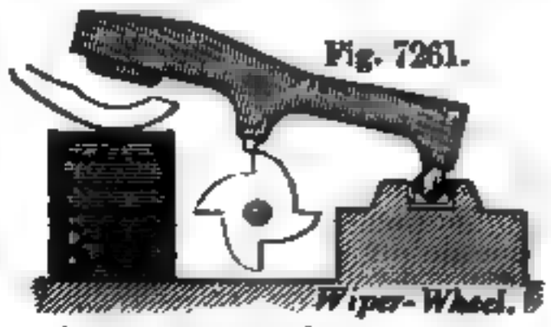


Fig. 7261.
Wiper-Wheel.

(*Small-arms.*) A steel implement having two twisted branches; it is screwed on the end of the ramrod, and carries a piece of cloth or some tow for cleaning out the bore of a musket. One accompanies each musket issued to the troops. Those of large size, used for cleaning out cannon, are fixed on a wooden staff, and are called *worms*.

The wiper for ordnance is called a *sponge*.

Wire-car'tridge. A cartridge for fowling in which the charge of shot has wire ligaments.

Wire-twist. A kind of gun-barrel made of a ribbon of iron and steel, coiled around a mandrel and welded. The ribbon is made by welding together laminæ of iron and steel or two qualities of iron, and drawing the same between rollers into a ribbon.

Worm. 1. (*Ordnance.*) An implement for withdrawing the cartridge from a cannon, when it is not desired to fire the charge.

It consists of two branches of iron or steel twisted in reverse directions, and attached to a staff. They are made of two sizes, one for field-guns and the other for siege and garrison guns.

2. (*Fire-arms.*) A spiral wire on the end of the ramrod, for withdrawing a charge. A *toad-hook*.

Xy-log'lo-dine. An explosive compound invented by Carl Dittmar of Charlottenburg, Prussia.

It is a fluid of milky, reddish, or white color, of a consistency varying from that of ordinary syrup to thick broth, and is intended to be mixed with cellulose or other porous substance to form *dualin*, though it may be used singly.

It is composed of nitric and sulphuric acids, and either glycerine-starch, glycerine-cellulose, glycerine-mannite, glycerine-benzole, or analogous substance.

In its preparation commercial sulphuric acid is boiled with pulverized charcoal until it is freed from nitrogen and attains the density of 67° B. 1½ parts of this, or 1 part of the purified acid and ½ part of fuming sulphuric acid, are mixed with 1 part of thoroughly purified nitric acid, specific gravity 48° to 50° B., and the mixture is allowed to stand in a close vessel for from eight to fourteen days, during which time it is subjected to blasts of hot dry air, for the purpose of freeing it from nitrogen.

Glycerine-starch is prepared by roasting starch on iron plates until it turns reddish or yellowish brown, and mixing it with glycerine of 30° B. or upward, free from fatty acids, lime, and chlorine.

Glycerine-cellulose is prepared by treating sawdust, preferably from soft wood, with dilute acid, as hydrochloric, boiling it with an alkali, and afterward drying, pulverizing, and roasting until it turns of a yellowish brown color; it is then mixed with anhydrous glycerine.

Glycerine-mannite is prepared by thoroughly drying and pulverizing mannite, and mixing it with anhydrous glycerine of 30° B.

Glycerine-benzole is prepared by mixing benzole, or benzole-toluole, with anhydrous glycerine of 30° B.

Either of the above, or other suitable substance, analogously prepared, is mixed with the acid mixture above described, in the proportion of about 1 part to 8 or 10 of the acids, and the compound treated to a bath of pure water, or placed in an iron or leaden vessel, when the acids separate from the nitrated compounds; the former being drawn off may be made serviceable for other purposes.

The nitrated substances freed from acid are placed in a bath of soda-lye and stirred until they impart a blue color to reddened test-paper.

They are again washed in pure water, and then rendered anhydrous by being placed in flat chambers and dried with sulphuric acid and chloride of calcium, at a temperature not exceeding 50° C.

A simple apparatus, consisting of a tank, with chambers or worms, and provided with suitable connecting-pipes, has been contrived by the inventor, for mixing and cooling the compound.

Dittmar's patent, for *dualin*, January 18, 1870, embraces "cellulose, nitro-cellulose, nitro-starch, nitro-mannite, and nitro-glycerine, mixed in various combinations, depending on the degree of strength which it is desired the powder should possess in adapting its use to various purposes." See DUALIN.

Xy-loid'ine. Another name for XYLOGLODINE (which see).

Cotton or other woody fiber treated with sulphuric and nitric acids. See GUN-COTTON.

Silencers

from the Home Workshop

by Bill Holmes

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Drawings by Lynna Brewer

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Home Workshop Guns for Defense and Resistance
Volume One – The Submachine Gun

Home Workshop Guns for Defense and Resistance
Volume Two – The Handgun

Bill Holmes is perhaps the best maker of firearms and accessories from the ground up. Don't be intimidated by the machinery shown in this work. In his two other works he shows many improvisations and alternatives to the more sophisticated shop machinery. Actually, with his two other books, HOME WORKSHOP GUNS FOR DEFENSE AND RESISTANCE, you can learn machining with the simplest of tools and machinery affordable by anyone interested in in the craft.

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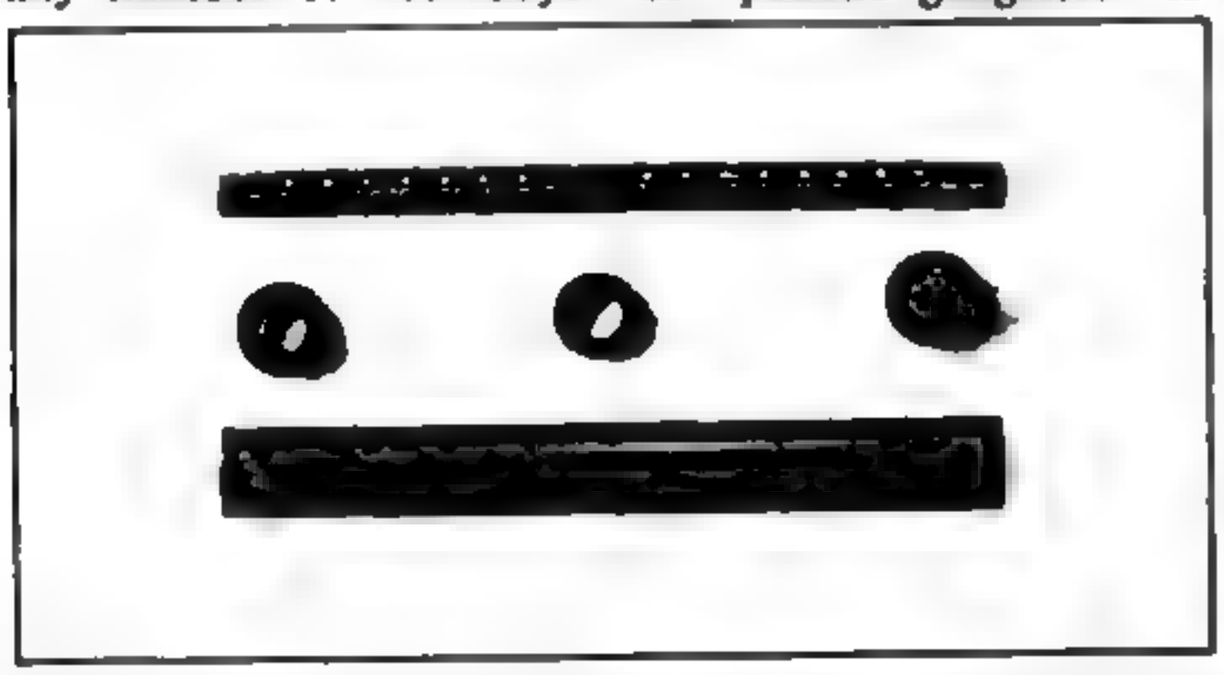
Silencers

I

Back several weeks ago when an acquaintance of mine, who is a would-be gun expert and professes to know considerably more about the subject than I do (he probably does), found out that I was getting ready to put this book together, he immediately informed me that such units are no longer referred to as "silencers." The term, "sound suppressor" is now the proper name for such an item and, according to him, no modern firearms student who knows what he is doing would refer to such a noise reducer by any other name. Very well, I am old fashioned and don't know what I am doing, but it will still be a silencer in this book.

Regardless of whether it is called silencer, sound suppressor, sound modifier, sound moderator, or just plain muffler, it is good for just two things. First of all, if you are caught in possession of one, it will almost certainly get you a lengthy stay in a Federal prison or a healthy fine or likely, both. The only other thing a silencer is actually suited for is to kill some one at a distance without making a lot of noise.

They do not have any practical use as a hunting or target weapon; so regardless of who may tell you that he or she wants a silencer on his or her .22 rifle so that he can hunt squirrels without disturbing his neighbors or so that he can target practice quietly, don't be taken in. He either believes that you are a fool or else he is one. There are also any number of "cowboys" or "psuedo gangsters" to



Component parts of Pistol Silencer consisting of: top–Sleeve, left center–barrel coupling, center–center bushing, right center–end cap, bottom–outer sleeve

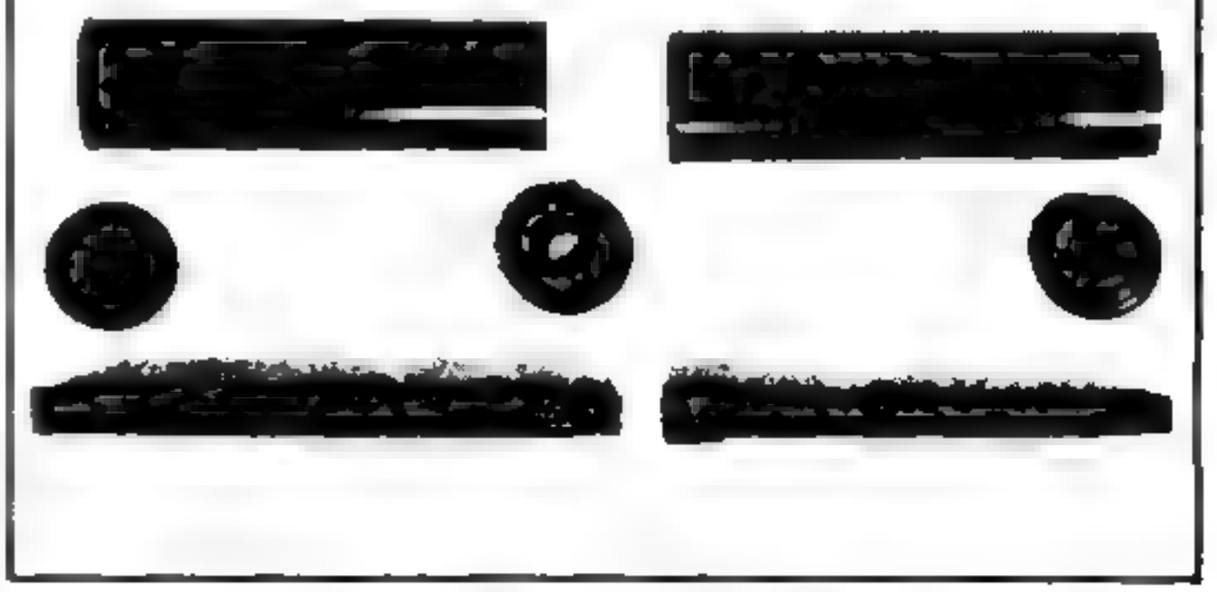
whom such a device holds considerable appeal. They desire to possess such an item simply because it is illegal and they think they are getting away with something. Don't fool with any of the above. If they express a desire for such devices, insist that they build it themselves; because if you help them and they are caught with it, you will get into trouble, too, just as surely as the sun comes up in the East.

I still believe that the day will come when a person's very existence may depend upon whether or not he has a weapon to defend himself and resist an enemy. These books of mine are meant to show you a way to create a suitable weapon for these purposes if and when such a time does come. Then, it won't make much difference whether or not such a weapon is legal. The people on the opposite side will probably kill you if they catch you anyway. This book, then, will purport to show a way (notice I said "a" way—not "the" way) to build a satisfactory silencer using tools and materials readily available. I will attempt to show how to build one for the submachine gun described in Volume One of Home Workshop Guns for Defense and Resistance and one for the semi-automatic pistol shown in Volume Two of the series. These designs can be adapted to many other firearms simply by making suitable barrel adapters.

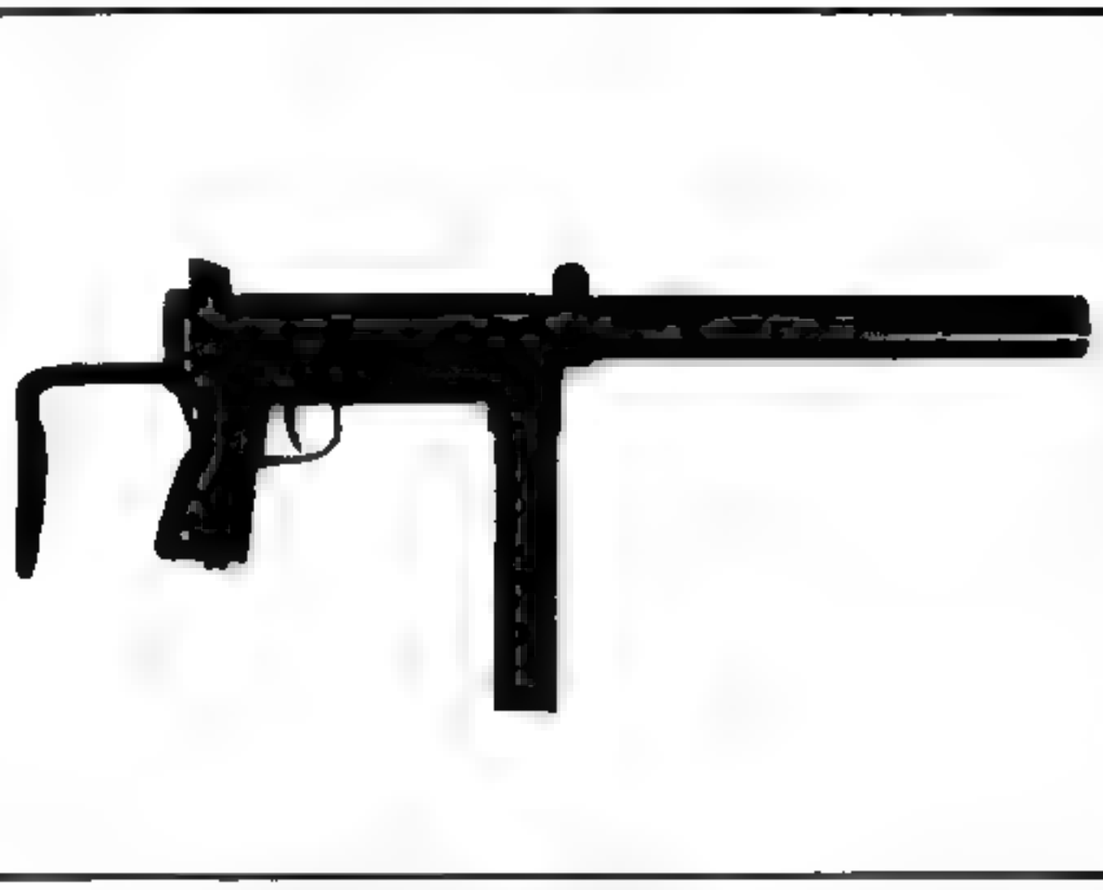
Incidentally, I am afraid several people have the wrong idea about what I am trying to do in these books. My primary purpose is to show methods of manufacture and ways that the average man can make the various parts in his home workshop.

The firearms designs are simply there to show a way to build such a weapon that can be modified, and probably improved on, in any number of ways. If you desire to change the designs, in any way, feel free to do so. However, please don't write me or call me and ask me to redesign them for you; and don't, for Heaven's sake, tell me that you are building one of these guns and ask me to

SMG Silencer Components



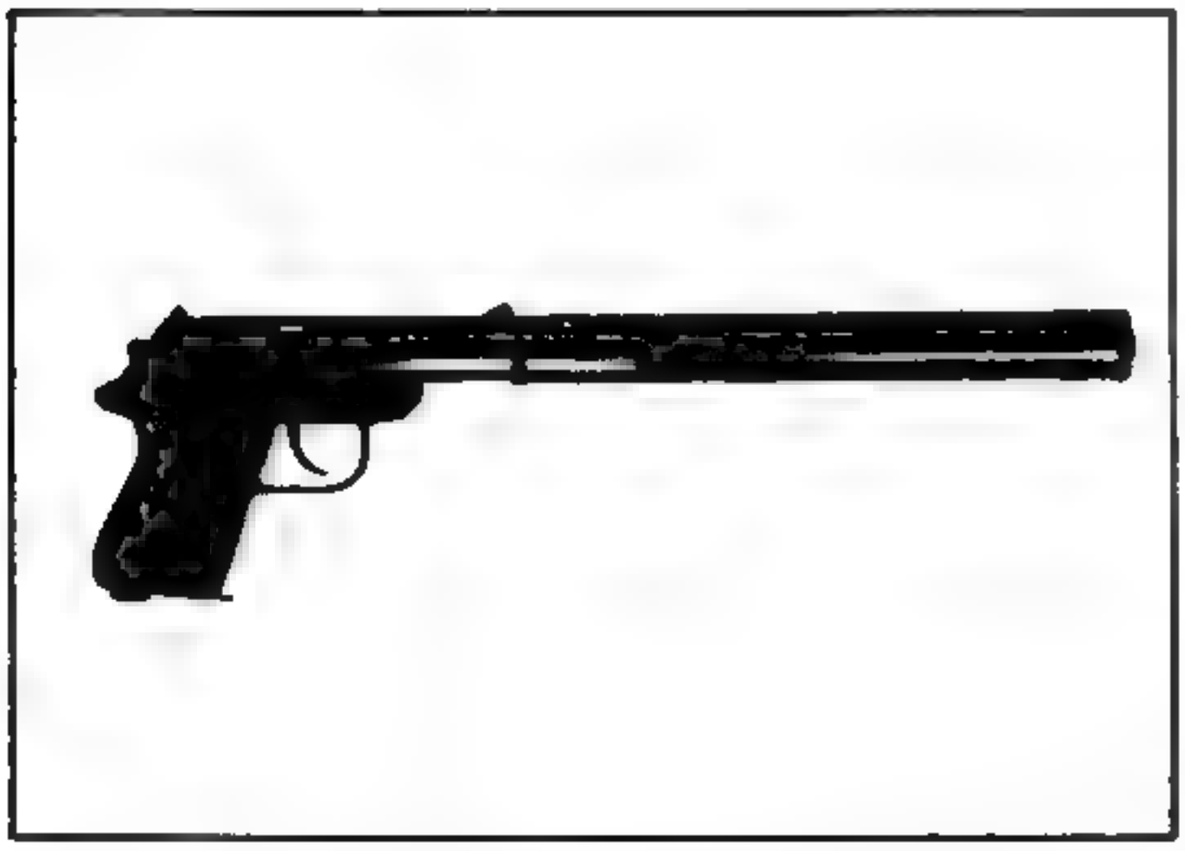
Top–outer tubes, Left center–barrel bushing, Center–coupling, Right center–muzzle cap, Lower left–barrel, Lower right–sleeve screen and insulation rolls not shown.



Home Workshop SMG with Silencer Attached

help you. If I did, it is possible, and probable, that I (and you) could be charged with conspiring to violate the Federal Firearms Laws. So if you ask me for help in these areas and I don't answer back, it is not because I am too cheap to buy a stamp or unwilling to take the time. Quite the contrary, I simply want to avoid any legal hassle and I have a strong aversion to jail; so please, don't get us both in trouble.

Contrary to what some people may believe, I am not an anarchist nor a clandestine arms maker. Rather, I am but a simple country boy with barely enough sense to read and write. About ninety per cent of my working time is spent building and modifying target shotguns. The rest is spent on experimenting with firearms designs and I do not have either the time or inclination to build illegal weapons. I have a family to support and I could not do a very good job of it in jail.

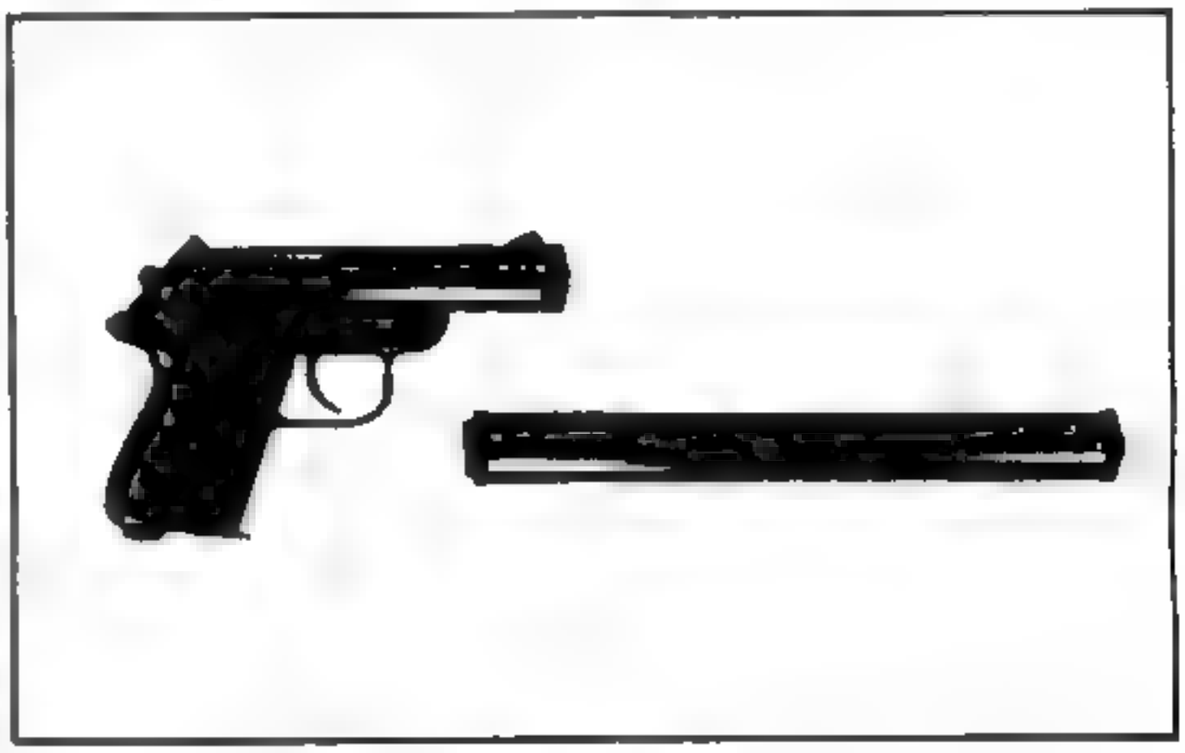


The Home Workshop Silencer Installed on the Home Workshop Pistol

II

Whatever name you choose to call it by, the silencer works about the same way an automobile engine muffler does. Both have expansion chambers to allow the gasses to lose energy and some means of absorbing or slowing down the gasses which delays and spreads out the escape of these gasses somewhat. Thus, the sharp crack that is present without the silencer in place is reduced or altered, depending on the efficiency of the unit used.

Contrary to what you may have seen on television or in the movies, silencers are long, bulky objects and not suited for use on revolvers due to the gas (and noise) leakage from the gap between the cylinder and barrel. Neither are they well suited to high-velocity cartridges since the ballistic crack of the bullet traveling at a velocity higher than the speed of sound is still present.



The Home Workshop Pistol with silencer unattached. To attach, simply remove muzzle cap and replace with silencer.

The most suitable weapon for such an installation would be manually operated, closed breech gun firing a bullet slower than the speed of sound. If an automatic or semi-automatic weapon is used, noise from the moving action parts as well as escaping gas from the opening breech will make enough noise to considerably impair the efficiency of the silencer as such. Therefore, some means should be used to lock the breech shut for each shot and the action cycled manually even when using self-opening weapons.

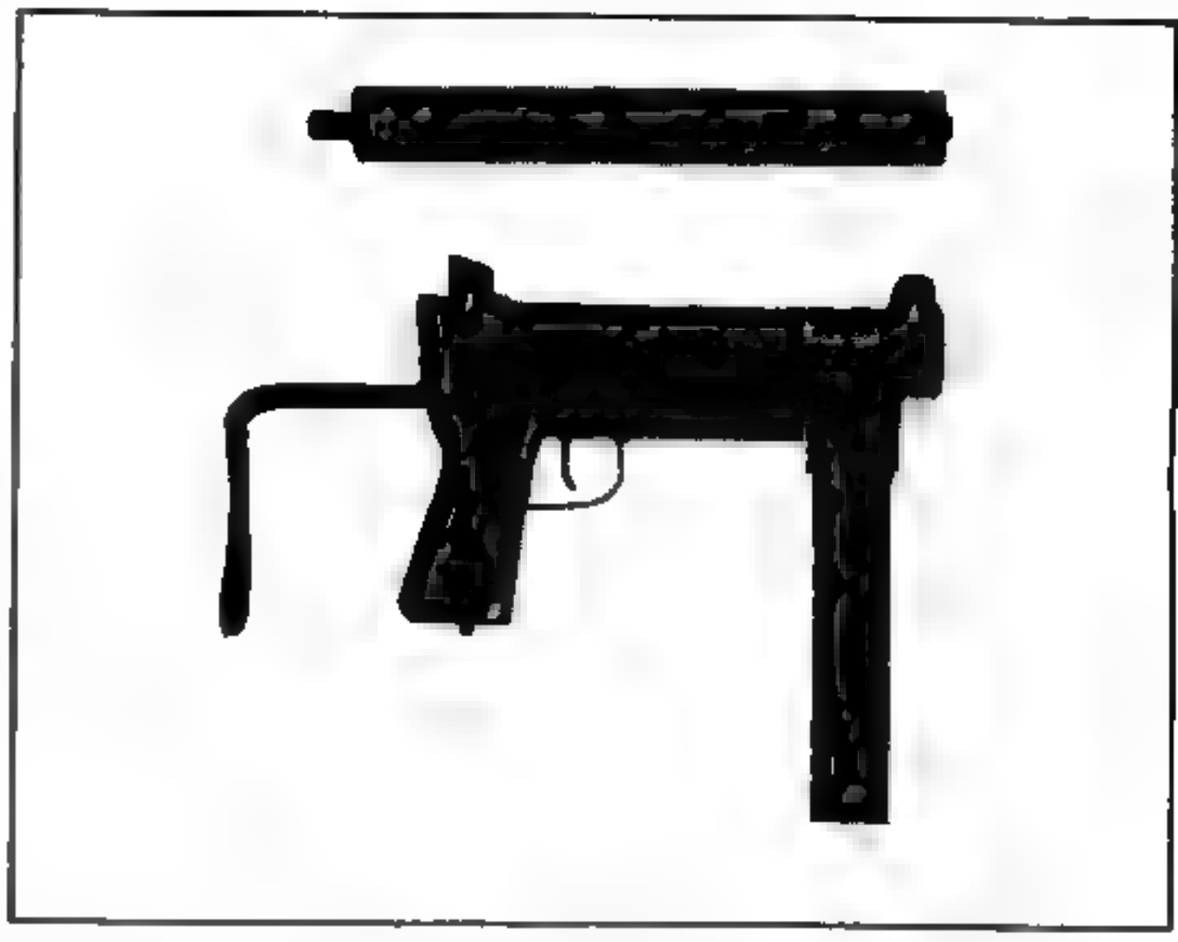
The designs shown here are about like most of the others, simply a series of sleeves, baffles, and absorbent materials enclosed in a tube with an opening for the barrel at one end and an exit hole for the bullet at the other. The clearance between the sleeve and the bullet should be as small as possible to hinder the flow of the gasses and prevent their rapid escape.

Needless to say, the opening for the bullet's passage

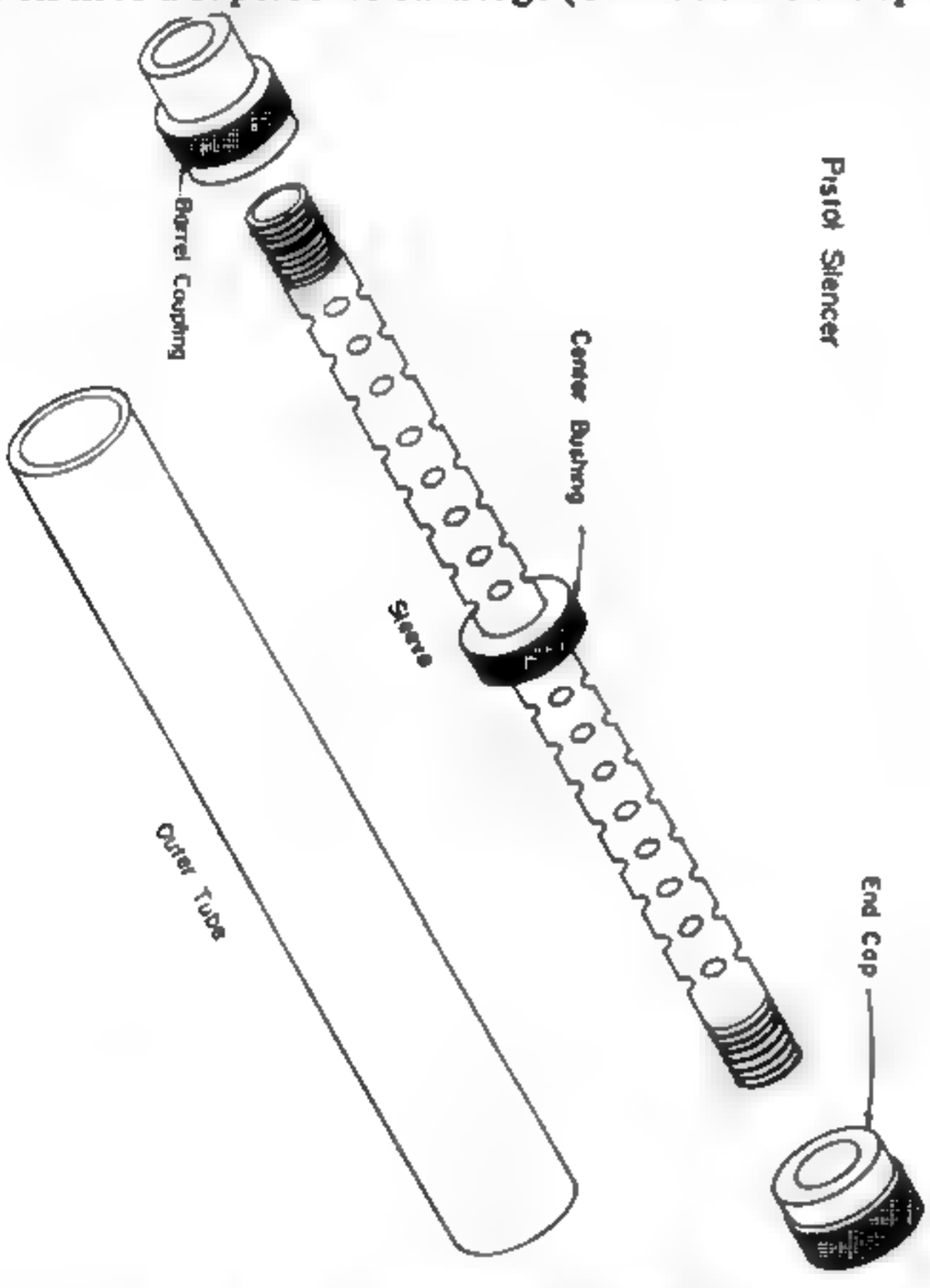
must be parrallel to, and concentric with, the bore, proper; otherwise, you may wind up with bullets coming out the sides of the silencer housing.

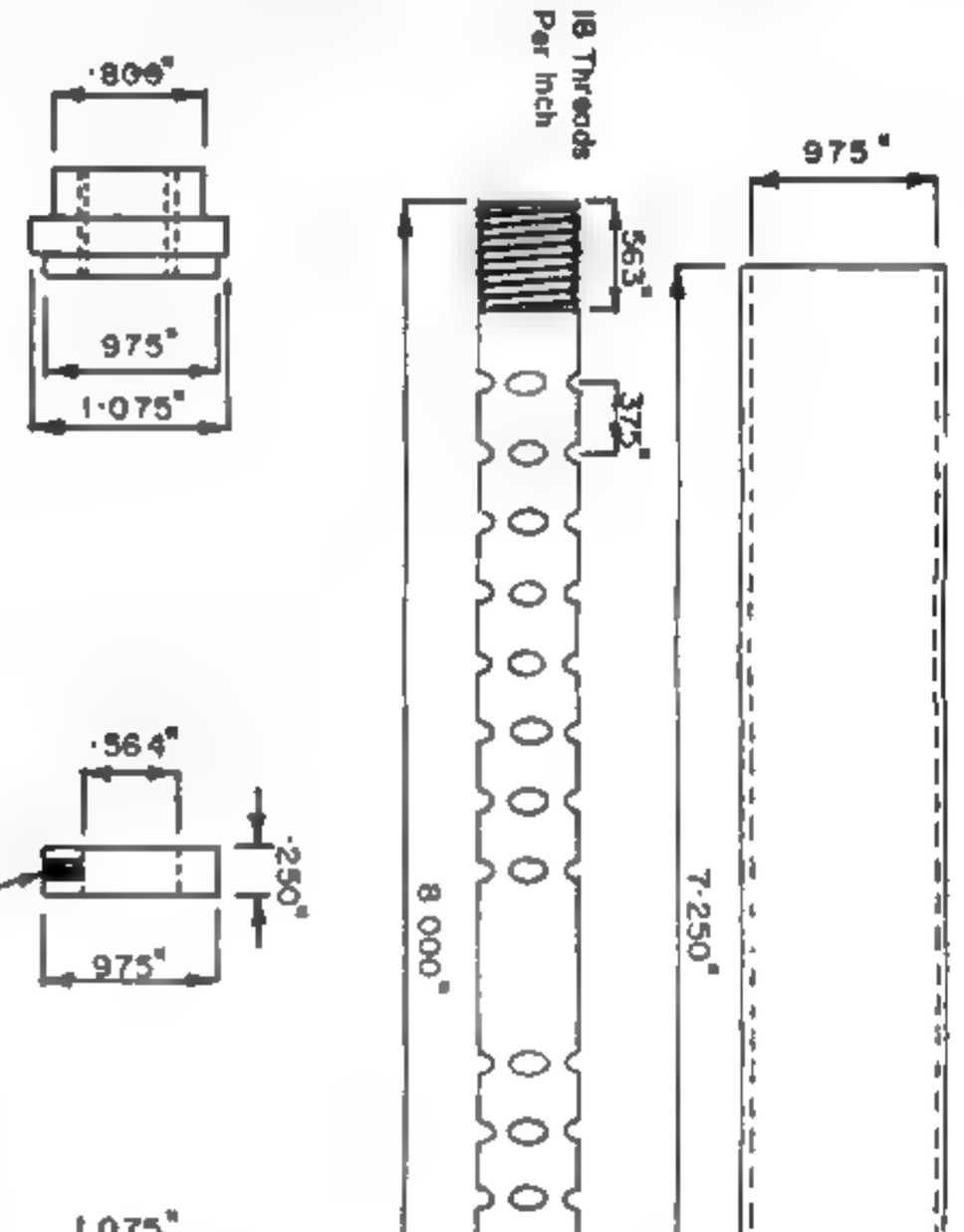
While I have shown rolled screen wire as the absorbent material in the expansion chambers of these designs, it is possible to use such material as steel wool or fiberglass insulation with equal effect, although it won't last as long. Discs of screen wire could be used in the forward end instead of the rolled fiberglass insulation with equal or better efficiency. It takes a lot of time and effort to cut and stack them into the unit, however, and the screen discs won't last a great deal longer.

If these devices are meant to be used on a firearm which fires a supersonic cartridge (bullet above the speed



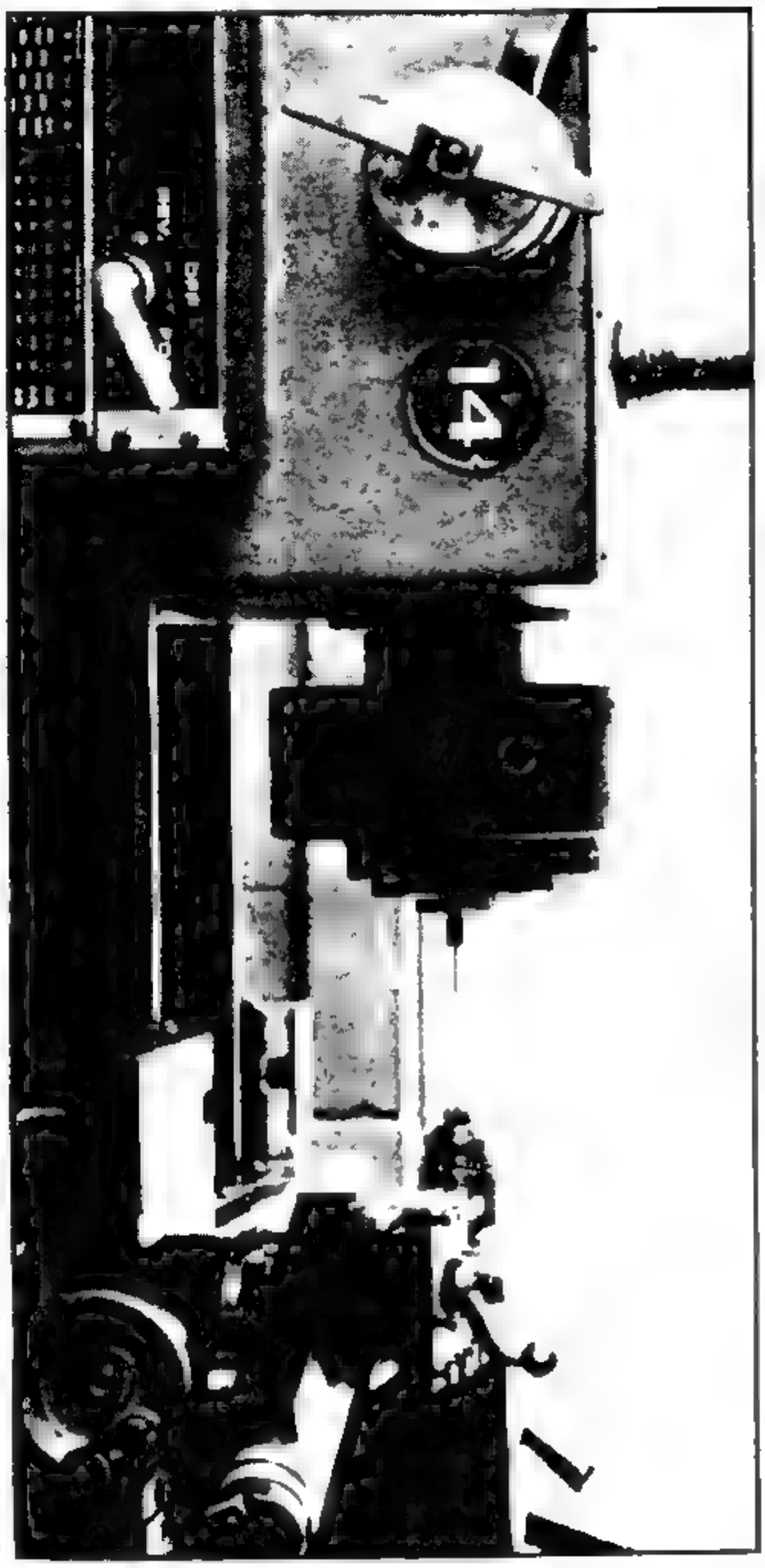
SMG with silencer unattached. Since the barrel must be ported (vented) and is incorporated into the silencer assembly, a separate barrel would be necessary for use without the silencer.





of sound) then it will be necessary to drill ports or holes in the barrel beginning slightly forward of the chamber which will allow enough gas to bleed off into the expansion chamber, thereby reducing the efficiency of the gasses and slowing the bullet to a subsonic velocity.

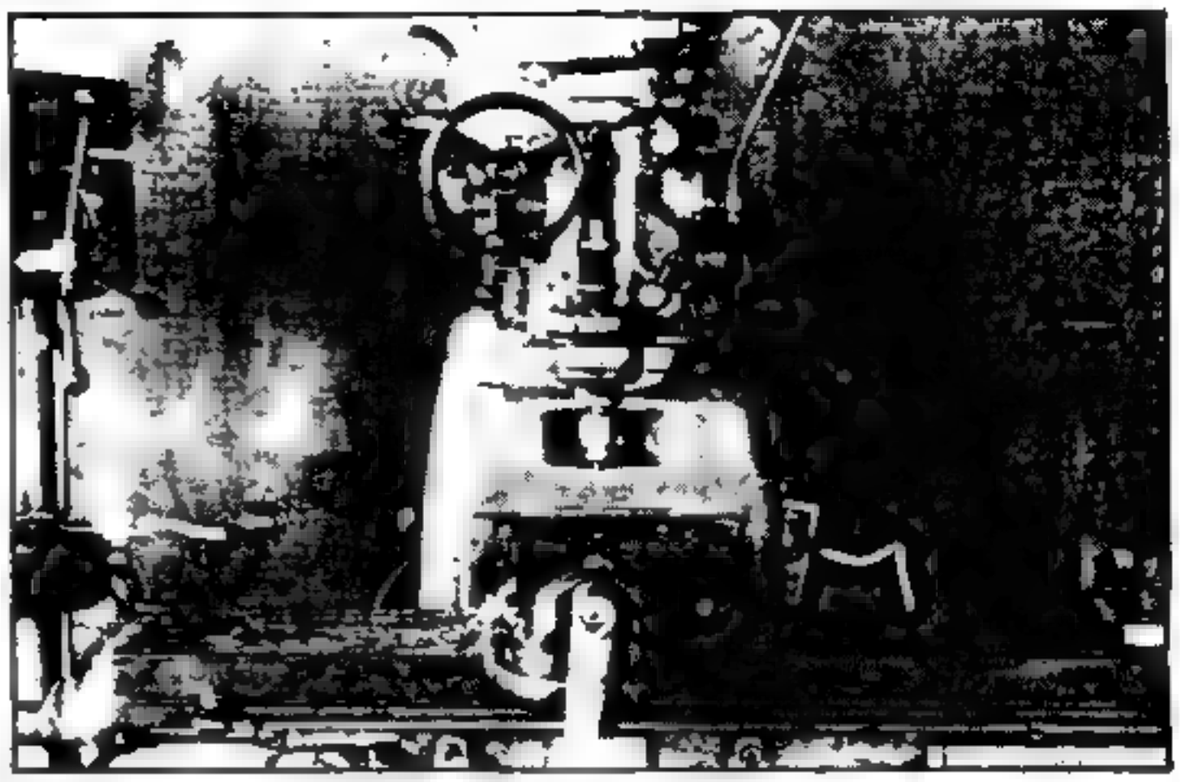
A sturdy barrel coupling or mounting ring is essential to proper operation. This should be made to fit tightly around the barrel and threaded and screwed on or pressed and pinned in place. The designs shown here utilize threads to secure it. However, many installations would be satisfactory pressed on and pinned. If the coupling hole is made



My own Clausing lathe set up to ream sleeve. This machine has 14" swing, 18" between centers, and has 1 1/8" hole through headstock. Adequate for most gun work.

approximately .005" smaller than the outer barrel diameter and the barrel placed in a freezer overnight and the coupling heated to about 400 degrees F just before pressing it in place, a tight enough fit will result that with a cross pin added will never come loose.

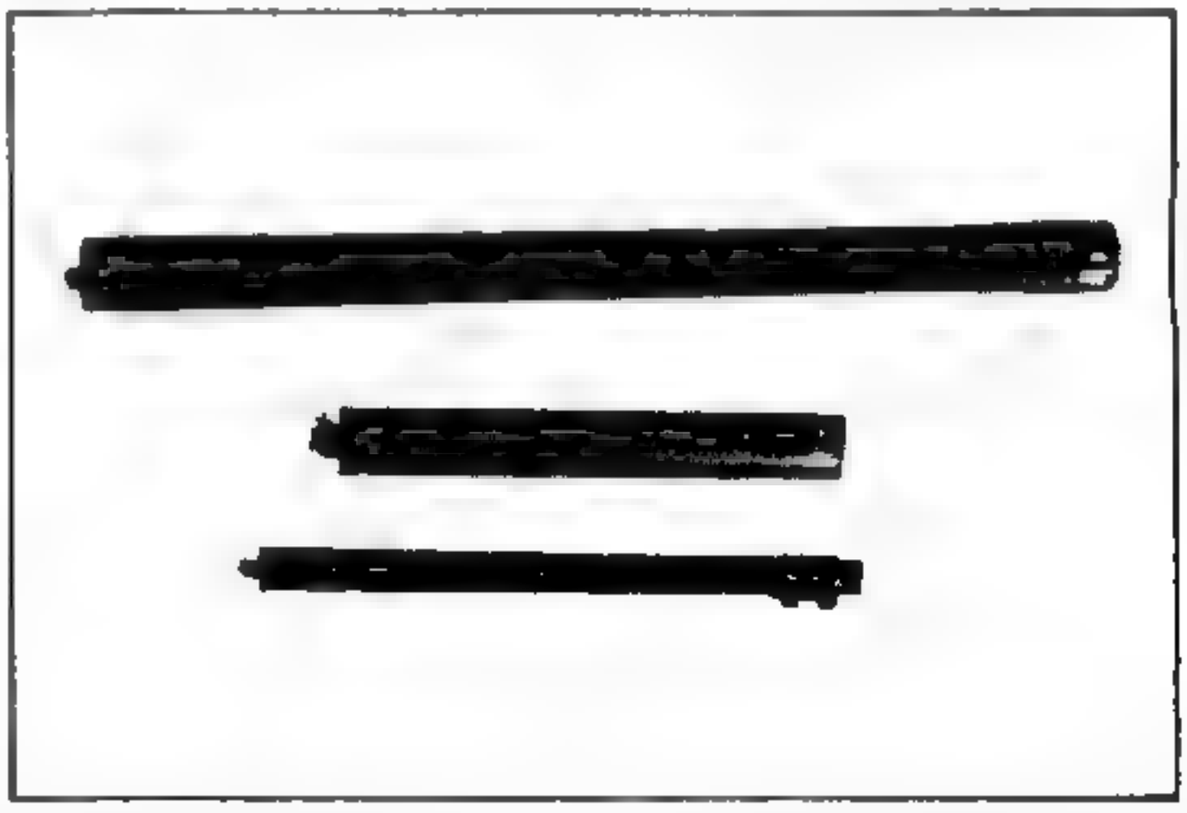
The barrel coupling for my semi-automatic pistol is built to the same dimensions as the barrel muzzel cap, which it replaces, except that it must be made longer and the forward end is a larger diameter to accommodate the rear end of the silencer body. Probably the easiest and cheapest source of material would be an automobile rear axle, which can usually be obtained from salvage yards at



My own Vertical Milling Machine, set up to drill vent holes in silencer sleeve. Naturally, the machine has some chips and shavings on it since I use it every day. With a machine such as this, together with a good lathe and some welding and heat treating equipment, almost anything that it is possible to make from metal can be built provided that the operator is capable of it.

comparatively small cost.

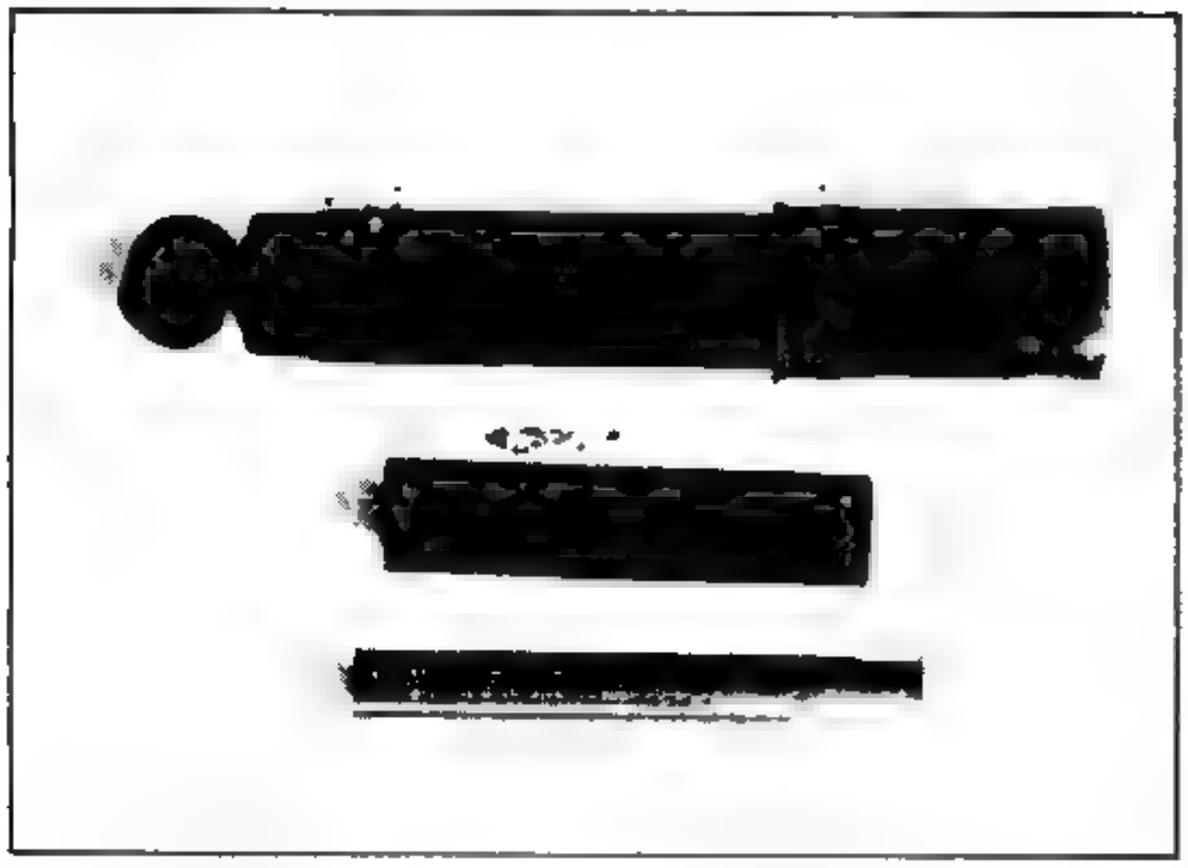
The barrel coupling, center coupling, and the end cap can all be bored and turned to the correct outside diameters as shown in the drawing after which they are cut apart, the ends faced square, and the center holes threaded as required. The measurements given in the drawings are appropriate only if the same size outer tubes as the ones I used are available. These dimensions must be changed as required to accommodate whatever size tube material is



All the material required to construct a silencer, except for screen and insulation. A section of automobile rear axle, shock absorber tubing, and a section of discarded military rifle barrel.

available to you. The thread specifications can also be modified to your requirements.

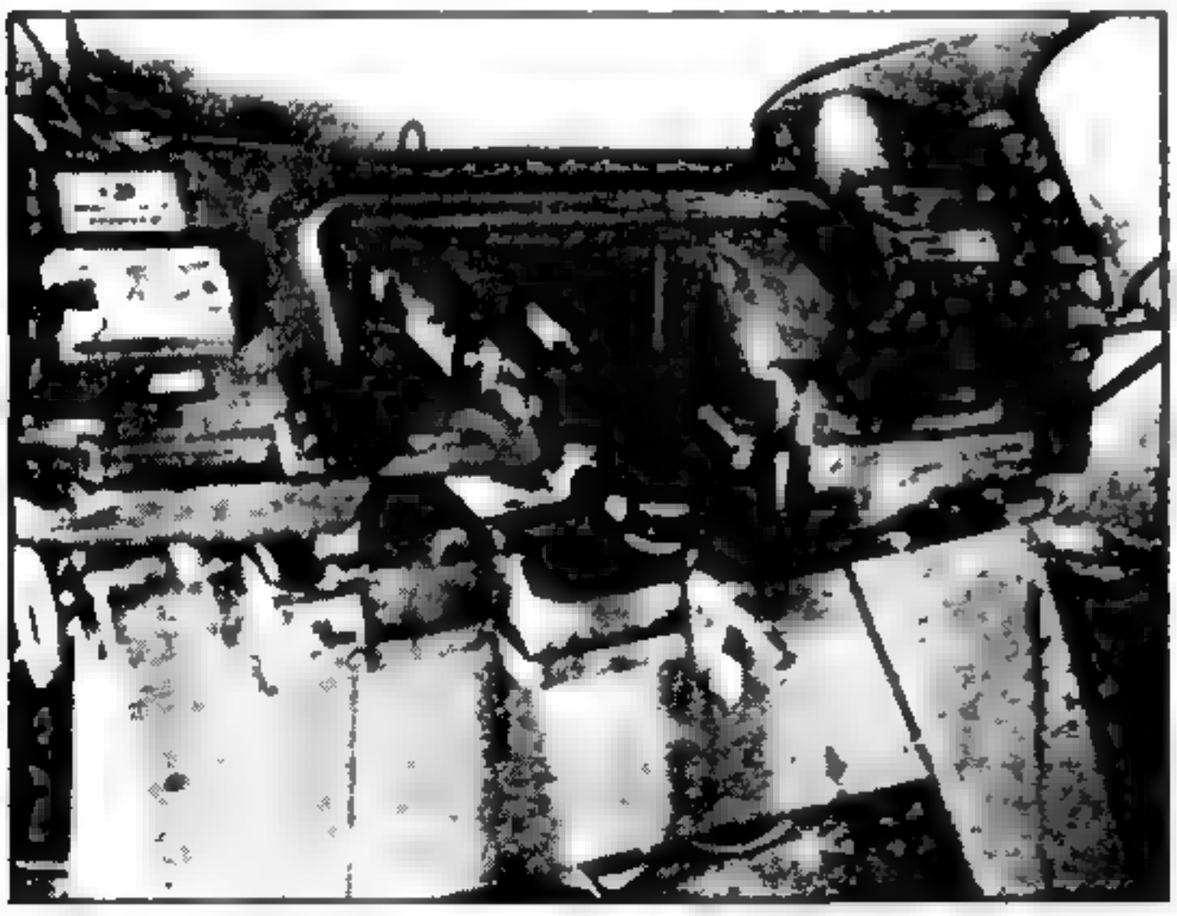
A sleeve approximately 8" long is turned and threaded on each end. One end will screw into the outer end of the barrel coupling. The end cap screws onto the other end, the flanged portions supporting and securing the outer



Tubing for silencer bodies can be obtained from discarded automobile shock absorbers.

tube in place.

This sleeve should be bored, reamed, and lapped to an inside diameter slightly larger than the bullet diameter. A section of discarded rifle barrel can be utilized here. A .30 caliber 8 mm barrel can be reamed to .358–.360 for the .380 caliber. Hand and chucking reamers are available from machine tool supply houses at modest cost which, when fitted with an extension long enough to reach from one end of the bore to the other, will ream the inside to the proper dimension which will be some two to five thousandths of an inch larger than the bullet diameter.

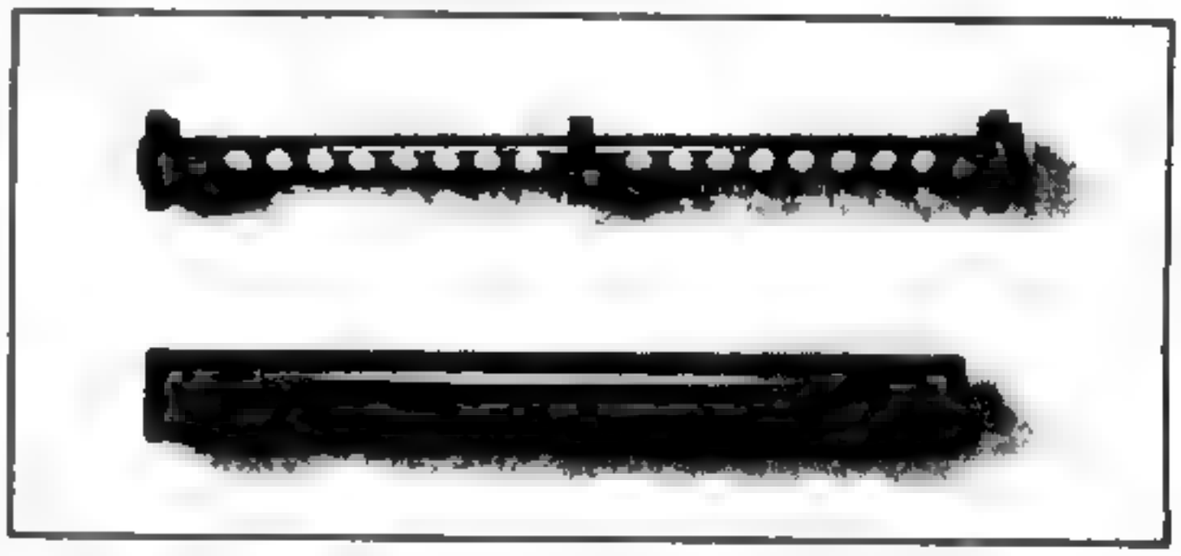


Sawing a shock apart to obtain tubing for the silencer body.

A sleeve for the .32 ACP caliber can be made from any barrel of .30 caliber or less. In this instance, the finished inside diameter should be .312" to .316".

The .22 caliber sleeve can be made from dicarded. 22 caliber barrel stock by reaming to an inside diameter of .225" to .229".

Before the final reaming and lapping operations are performed on the sleeve, four parallel rows of vent holes should be drilled along the axis of the bore. These allow gas to vent into the absorbent material surrounding the sleeve which, in turn, deadens and muffles the sound. These holes should be evenly spaced around the circumference of the bore in four rows spaced 90 degrees apart with nine holes spaced .375" (⅜") center to center between the barrel coupling and center coupling and four more rows of eight holes each between the center coupling and muzzle cap. These holes should be .1875" to .200" in diameter for the .22 caliber silencer and can be .250" to .300" for the .32 or .380. If these holes are drilled before the final inside diameter of the sleeve is reamed and lapped, any burrs thrown up on the inside surfaces will be removed by the final reaming.



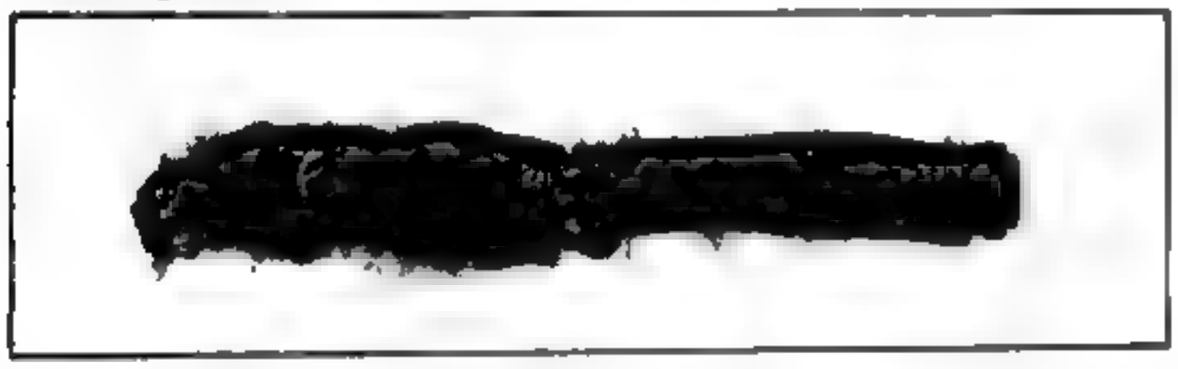
Sleeve with barrel coupling, center bushing, and end cap in place, shown with outer tube underneath.

Drilling these vent holes, perpendicular to the bore, evenly spaced, and in a straight line is best done in a vertical milling machine. The next best alternative would be holding the sleeve in a lathe milling attachment and feeding it into the drill, turning in the lathe chuck. Lacking either of these, a drillpress or hand drill may be used provided that the hole locations are properly center punched and started with center drills. This procedure is described in detail in Volume One of the Home Workshop Guns for Defense and Resistance.

Silencer with outer body partly assembled showing screen roll in position.

The outer tube can be made from various types of tubing, pipe, etc., the only requirements being that it is fairly stiff and consistently round for its entire length. Automobile shock absorber bodies contain material well

suited to this application and usually service stations and garages that install shocks on automobiles are happy to give away the worn shocks that they have removed, just to get rid of them. The inside cylinder on the one I used for this installation measured 1.075" in outside diameter and .975" inside diameter which means it has a wall thickness of .050". This cylinder was cut to a length of 7.750" and then ends squared in the lathe, thus creating a satisfactory outside sleeve for the silencer with a minimum amount of expense and labor. As previously mentioned, the outer and inner diameters of such cylinders salvaged from shock absorbers varies considerably and the diameters of the barrel coupling, center coupling, and end cap must be modified from the dimensions shown in the drawings to match the diameters of whatever cylinder of tube that you come up with.

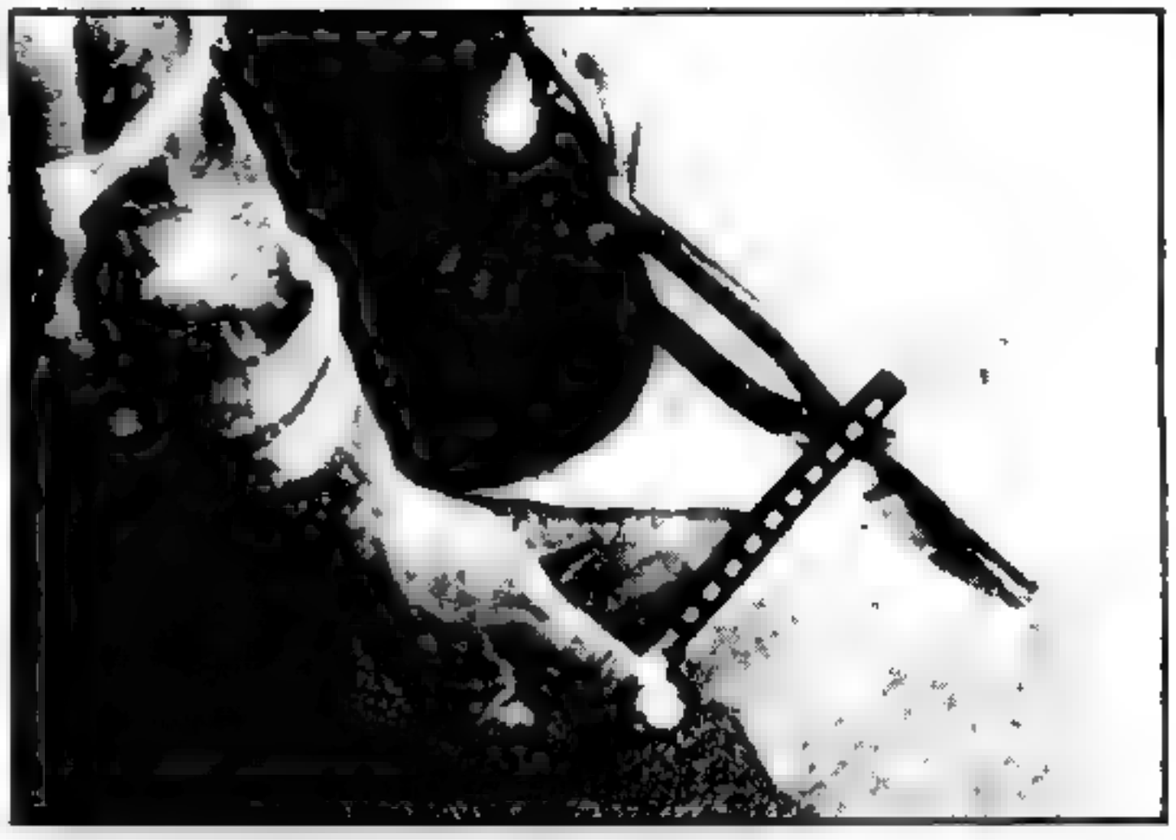


Sleeve with screen roll and insulation in place

The parts should now be blued or finished in whatever fashion that you desire. Hot nitrate bluing is described in Volume One of Home Workshop Guns for Defense and Resistance and instructions on how to apply a rust blue are contained in Volume Two.

If the end cap and barrel coupling are knurled around the circumference of the exposed portions as shown in the pictures, it not only improves the appearance but also provides a gripping surface to grasp with the fingers when tightening or loosening these parts.

Common metal window screen can be salvaged from buildings, is available from hardware and building supply stores. Can be cut with sheet metal shears.



Metal screen is cut to proper width, using sleeve as guide.

The silencer is initially assembled by screwing the barrel coupling in place on the end of the pistol barrel replacing the original muzzle cap. The sleeve is then threaded into the other side of the barrel coupling until it butts up against the pistol barrel muzzle. It is then locked in place with a set screw as shown.

A strip of metal screen wire just wide enough to fit between the barrel coupling and center bushing is wound tightly around the barrel until it fills the space between the barrel coupling and center bushing. The outside diameter of this screen roll should be such that the outer tube will just slip over it.

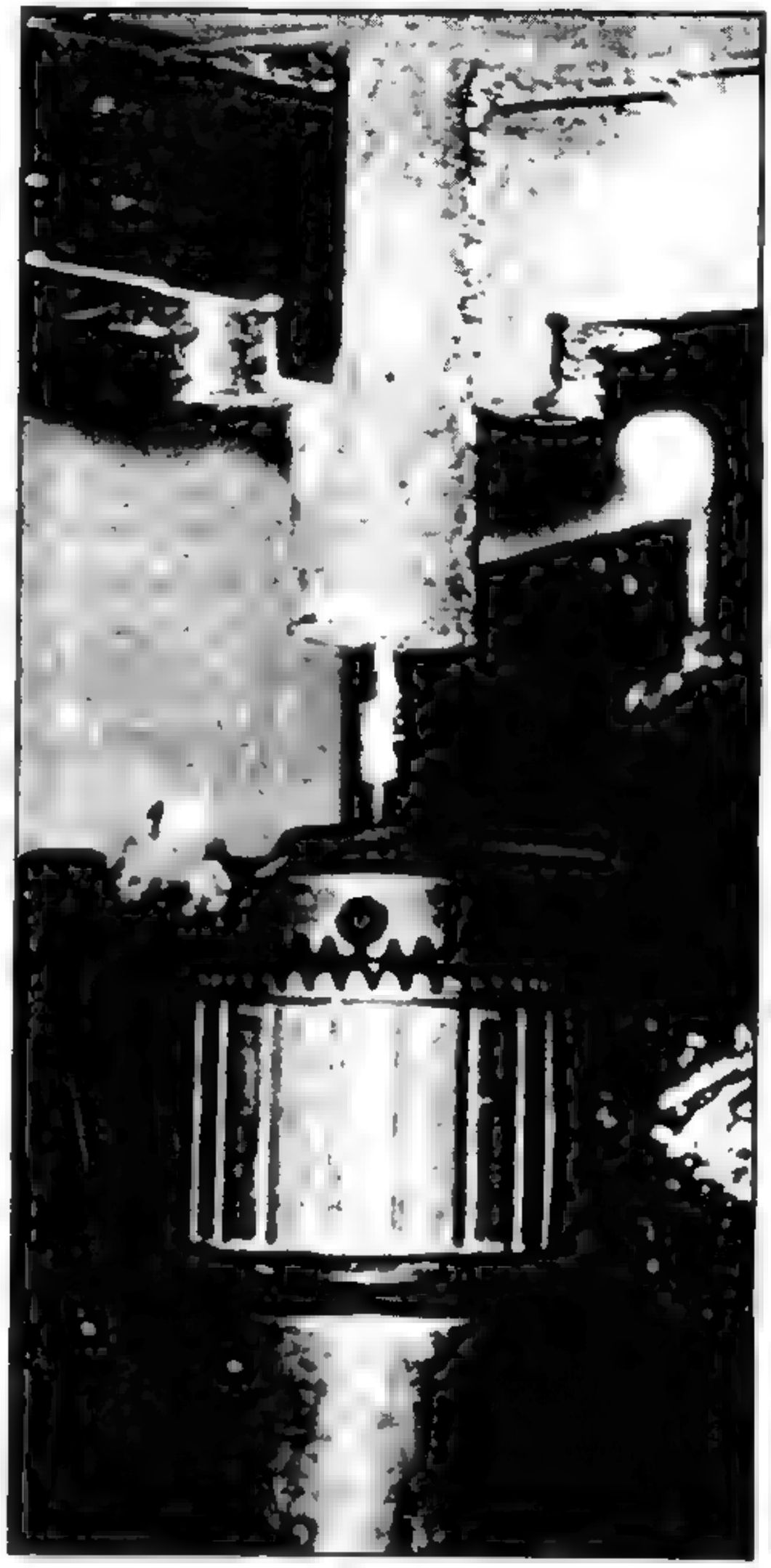
The front portion between the center bushing and muzzle cap should be filled loosely with a roll of fiber glass insulation, steel wool, or whatever other sound-absorbent material you deem appropriate. An acquaintance of mine, who experiments with items such as this, told me that "silly putty" works well for this; but I have always used the rolled fiber glass as shown.

To assemble, the fiberglass strip is rolled loosely around the sleeve and the outer tube slid over it back to the center coupling, at which time the screen is wound around the sleeve and the outer tube pushed over it and to the rear until it contacts the shoulder of the barrel coupling. The end cap is now screwed onto the end of the sleeve, the shoulder supporting and securing the outer tube in place.

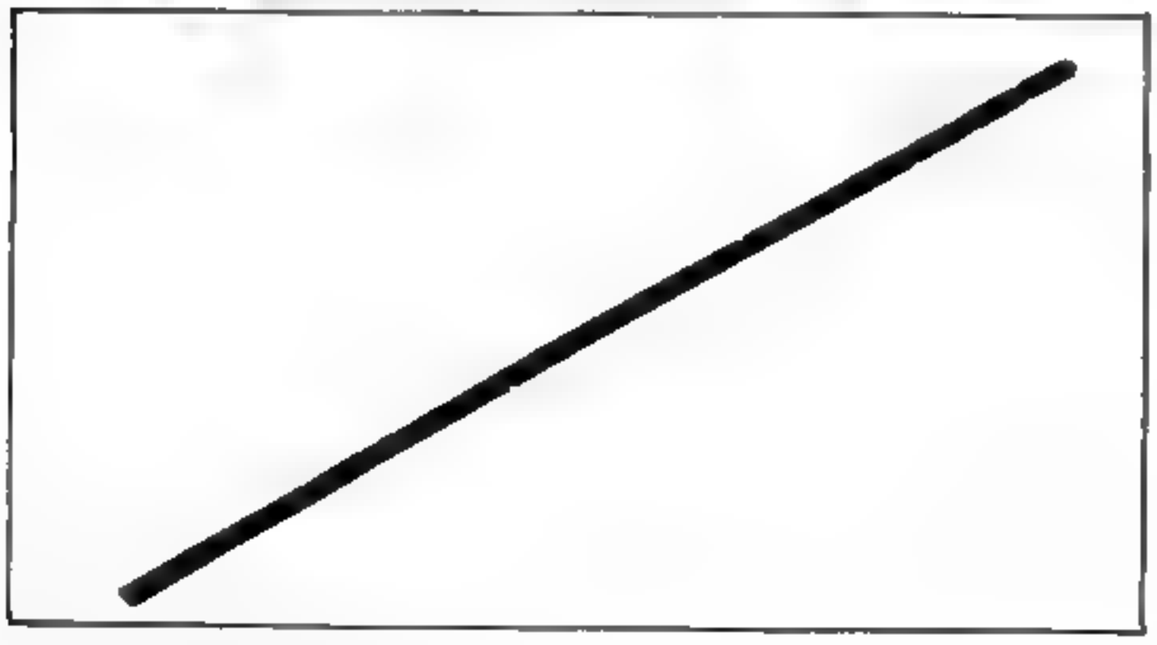
The unit is now ready to test fire. As with any firearm being tested for the first time, precautions should be taken to avoid injury in the event that the unit should blow apart.

At least, wear a heavy glove and hold the gun around the corner of a building or around a tree, or best of all, under a heavy board so that your face and body will be protected in case parts and pieces do start flying.

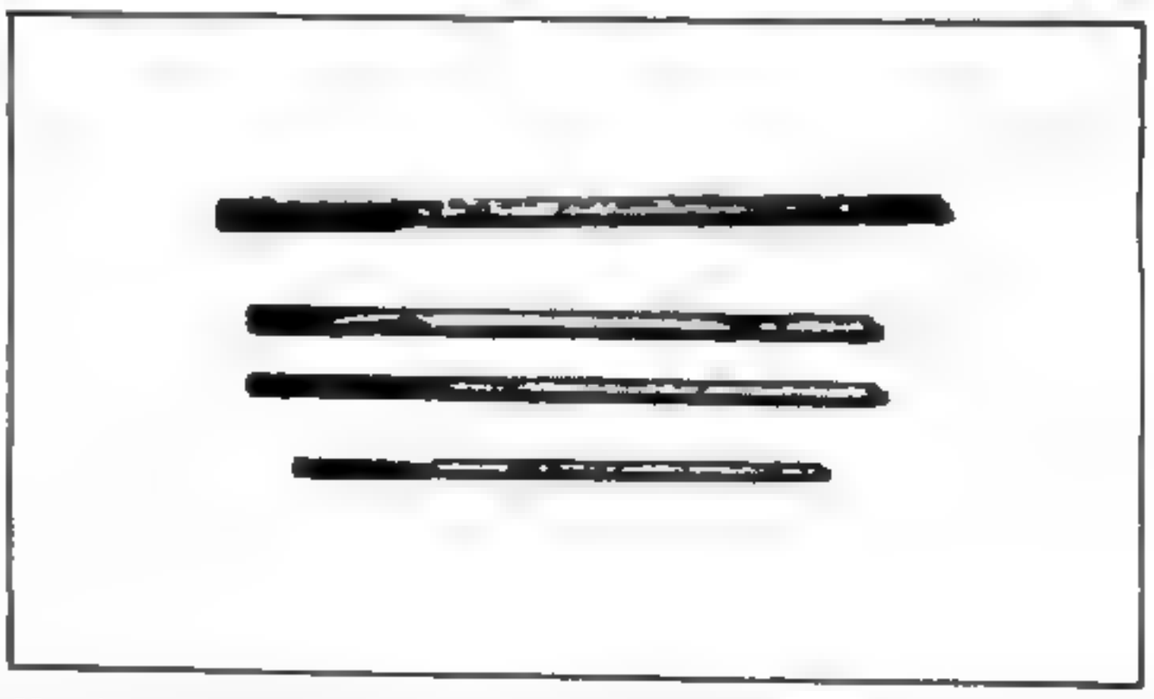
End of automobile axle is faced square before drilling.



Hole is started with center drill.

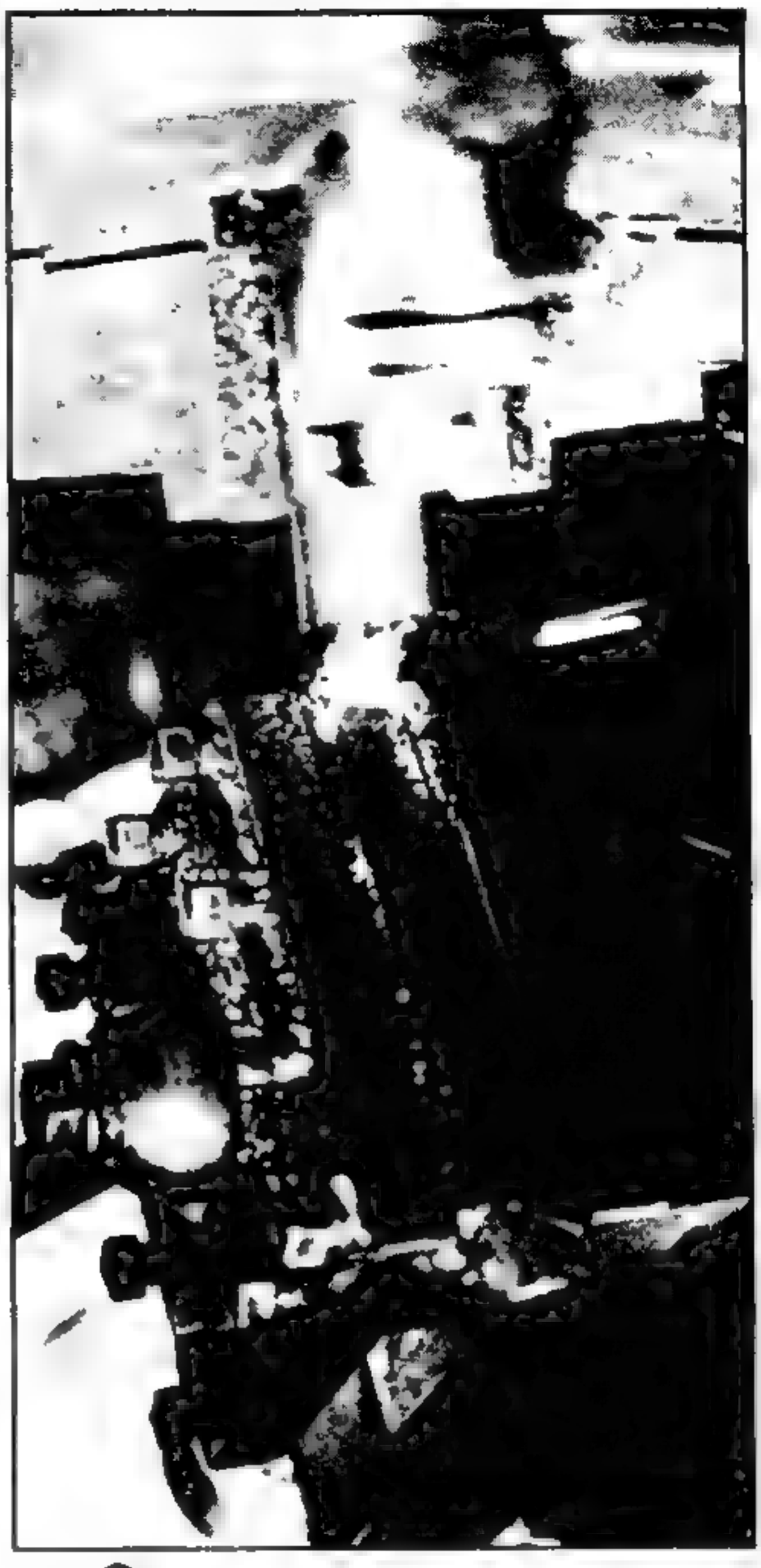


Long shank drill for boring sleeve to larger diameter can be made by turning down drill shank and boring an extension to a slip fit over the drill shank. Silver solder in place.

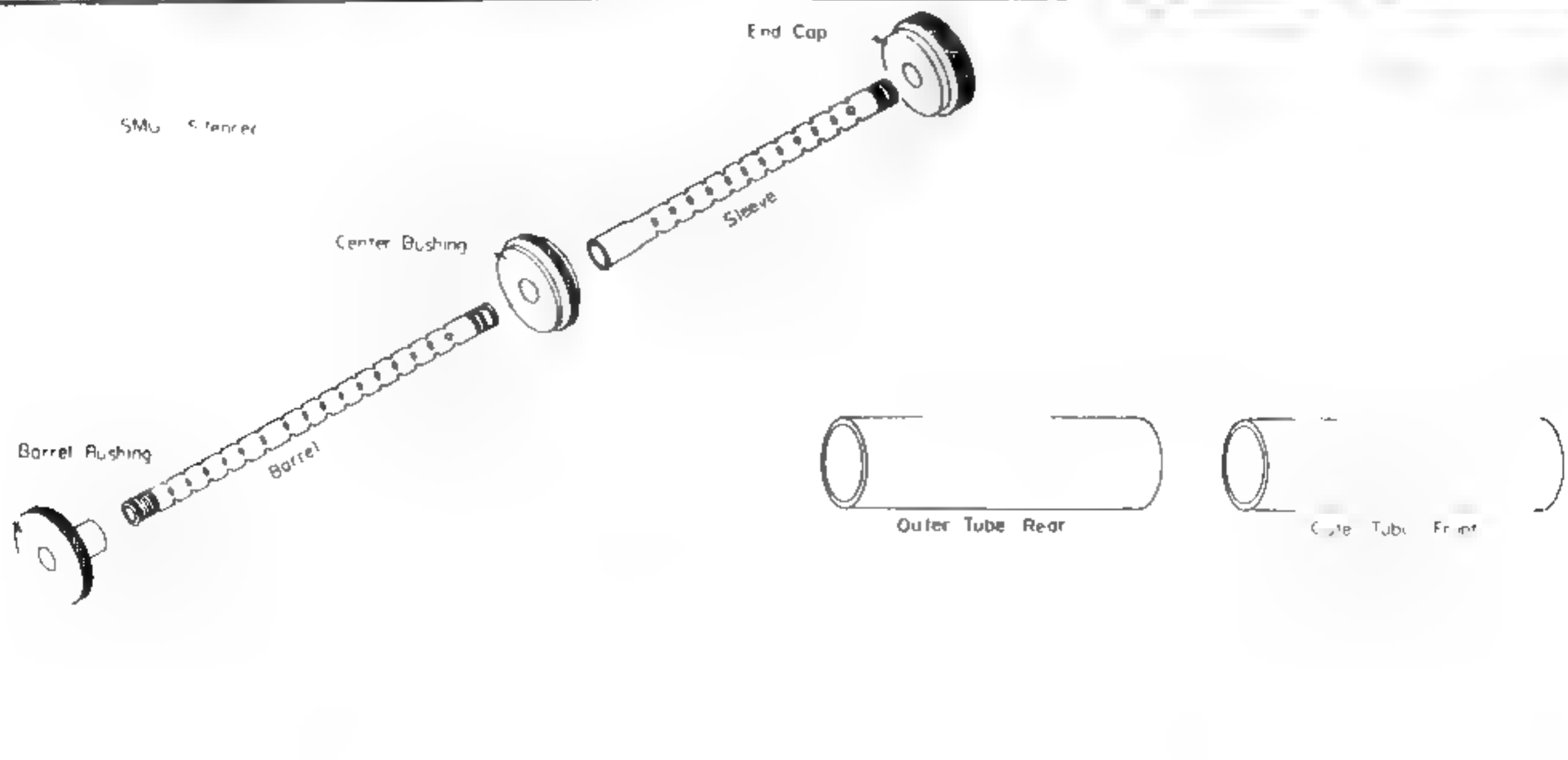


Hand and chucking reamers can be had in just about any size desired. Available from machine tool supply houses.

Hole is drilled to required depth using proper size drill. Smoother, more accurate holes result in most instances if a smaller drill is used first followed by the larger full size drill.

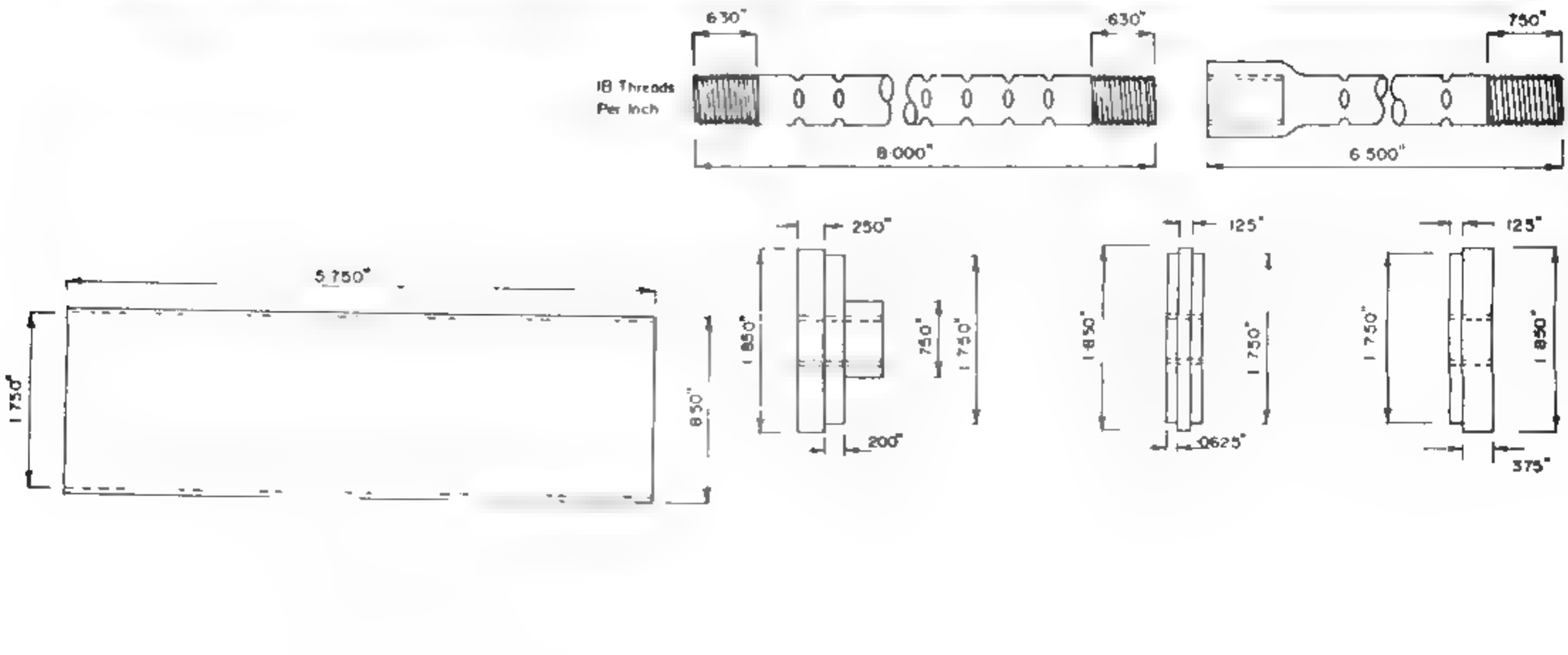


Tubing is cut to proper length and faced square on ends.



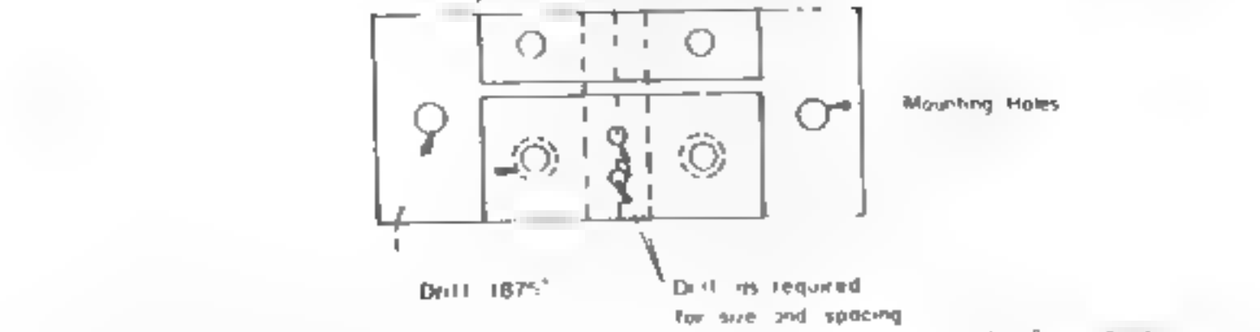
Ends of sleeve are threaded to receive barrel connector and muzzle cap.

Set up to ream sleeve to .228 I.D. Reamer is fed in slowly, cleaned frequently, plenty of lubricant is used.



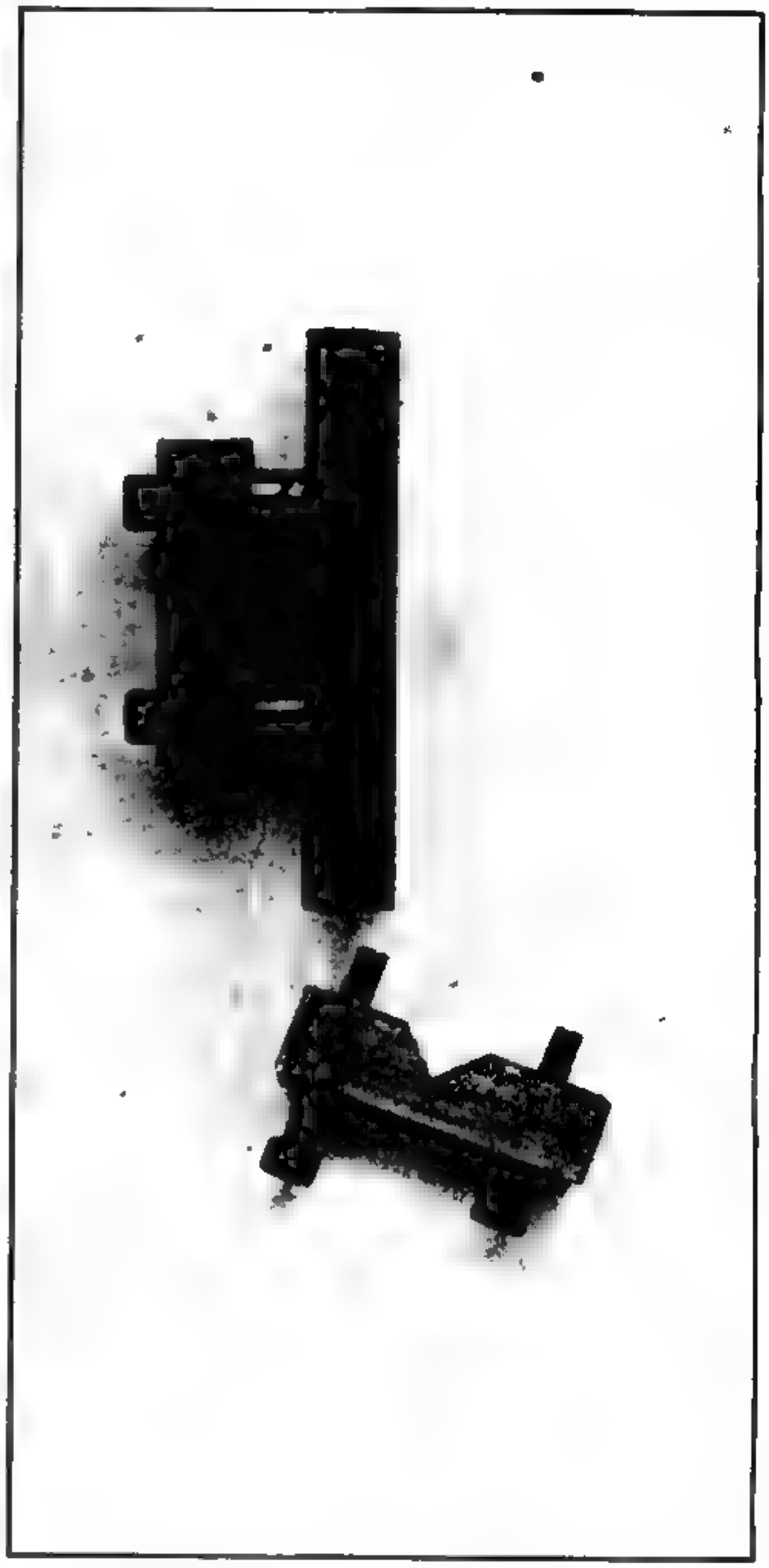
Sleeve is reamed to proper diameter, preferably after vent holes are drilled.

Jig to locate and drill vent holes in silencer sleeve.

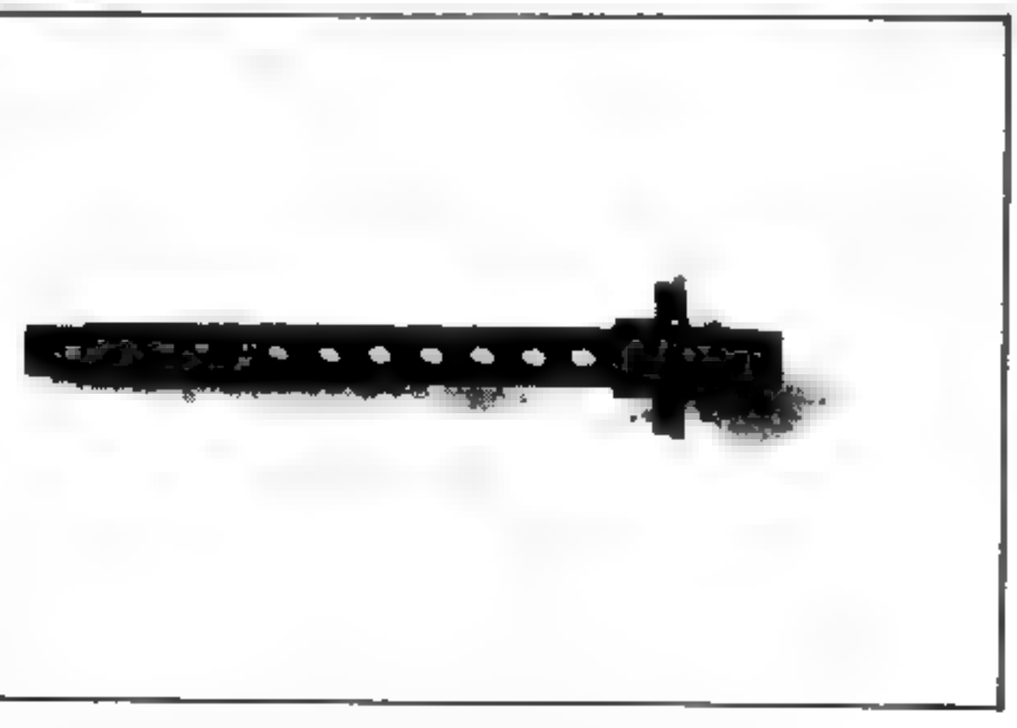


DRILL JIG

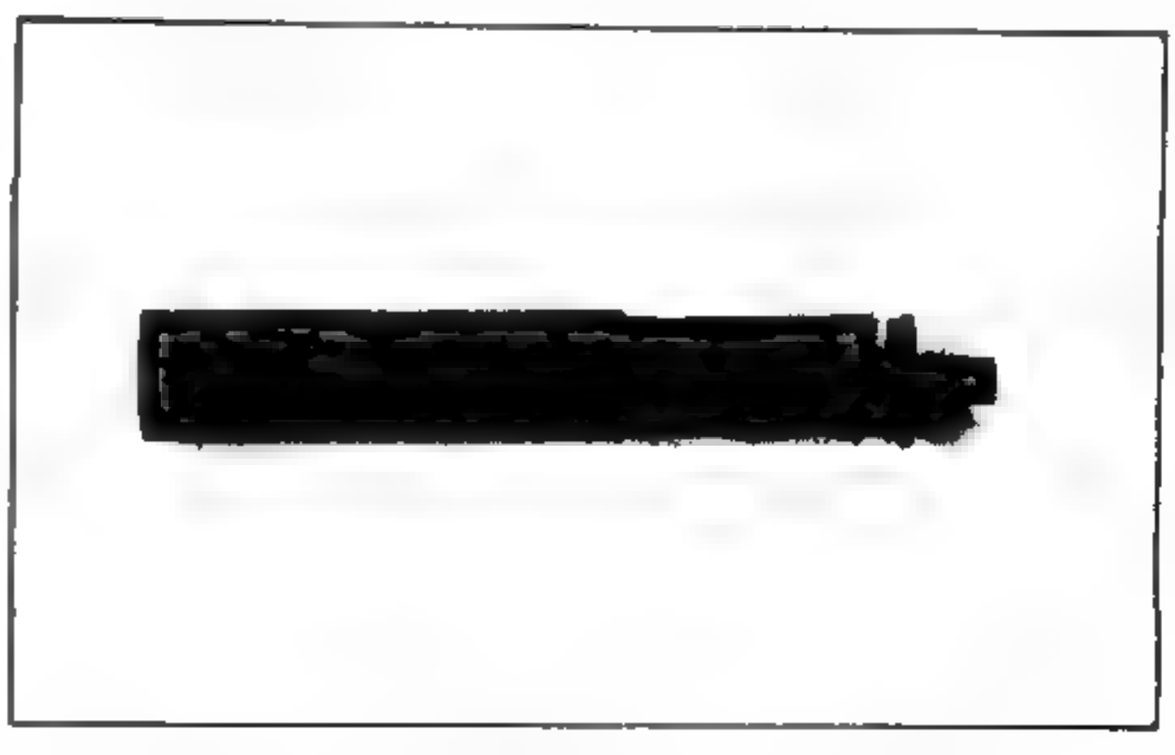
Jig shown with sleeve in place.



End view of drill jig with clamp removed. Vee ways can be cut with file if no milling machine is available.

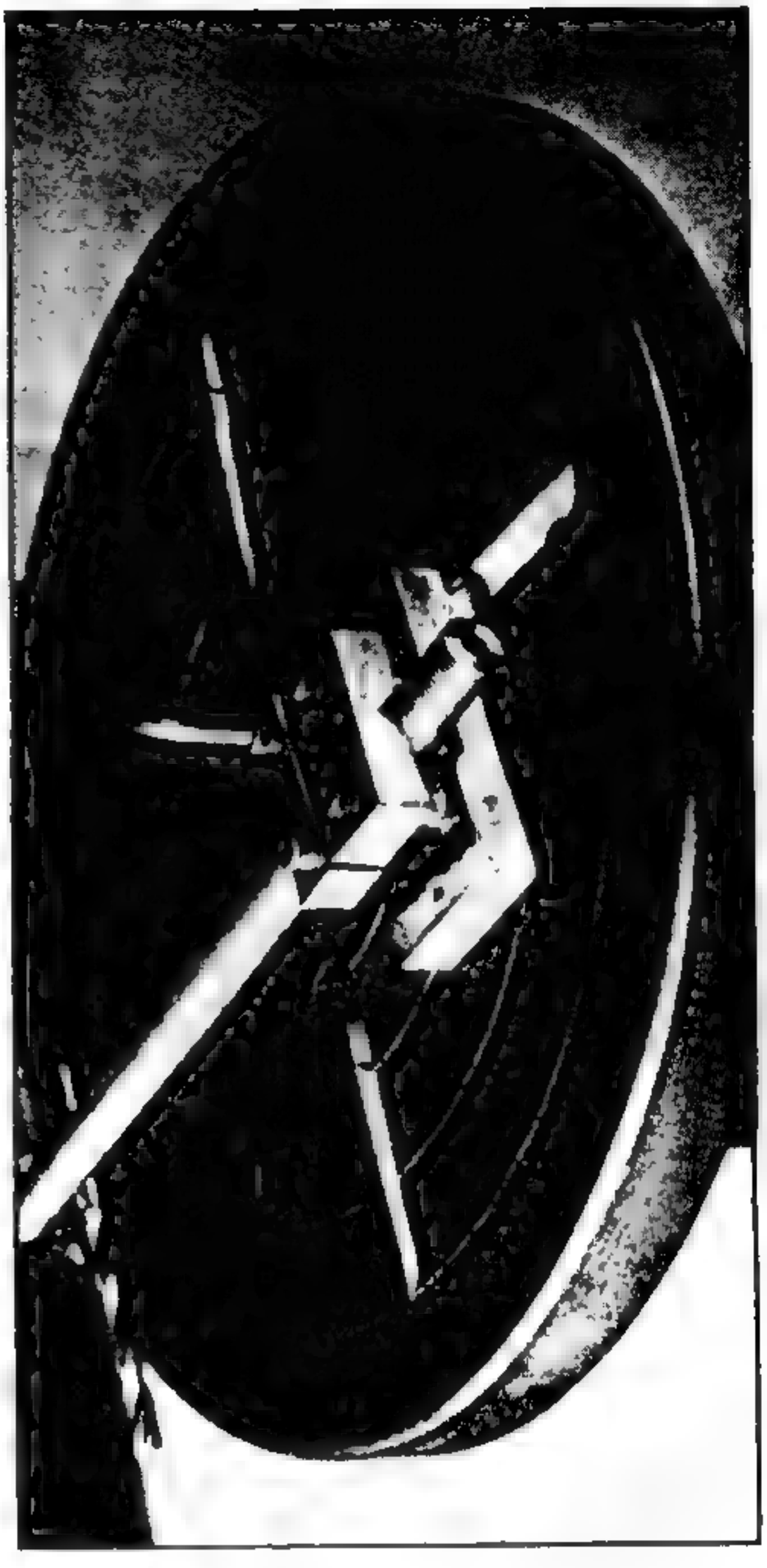


Assembly begins by installing barrel bushing on barrel.



Screen roll is placed around barrel and rear outer tube pushed over it.

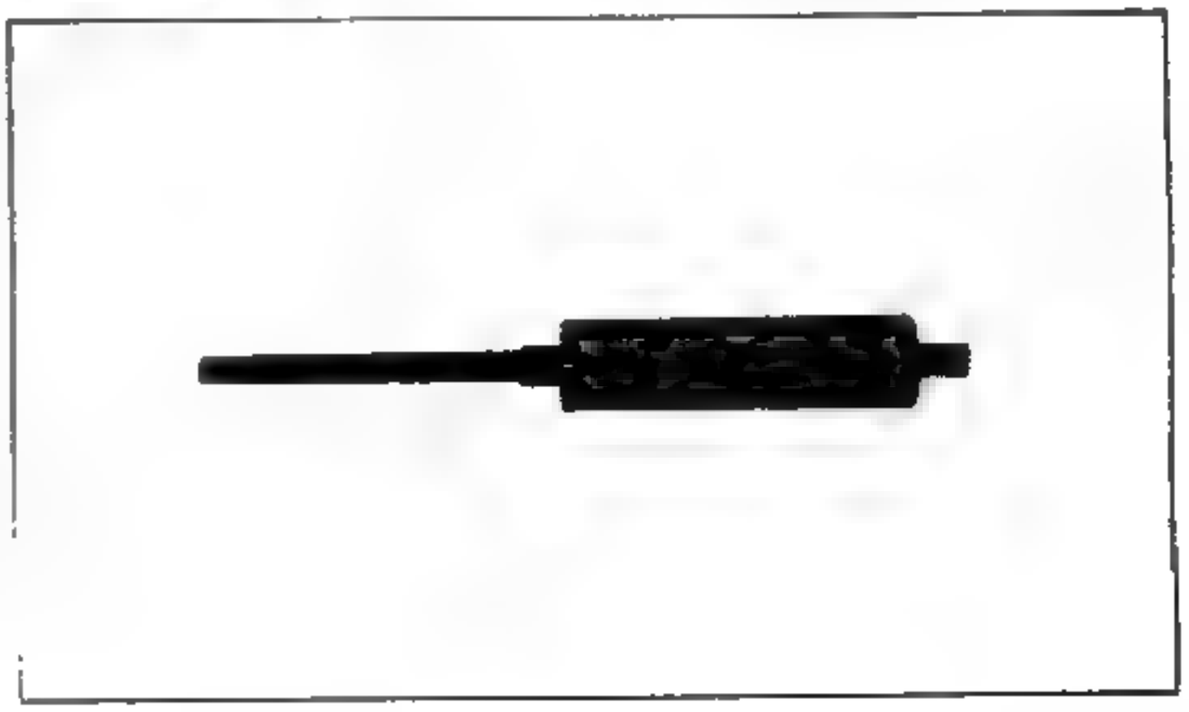
Top view of drill jig. Clamp removed. The holes near the outside edges are mounting holes to allow the jig to be fastened to something solid for use with a hand drill.



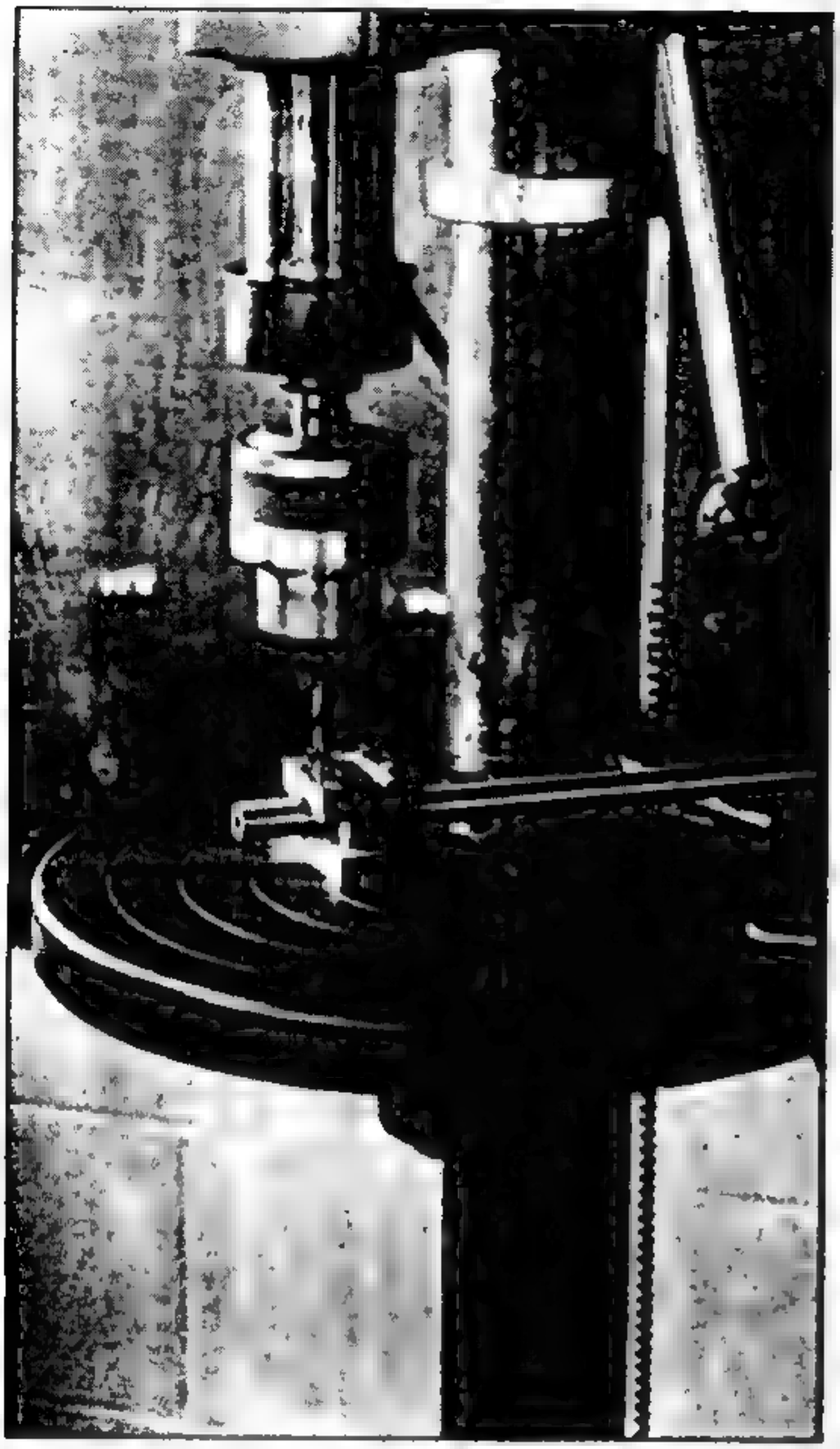
Drill jig ready for use with drill press.

The sub machine gun silencer is made pretty much the same way as the pistol silencer except that a barrel bushing is made to screw onto the rear end of the barrel in place of the barrel lock nut and is locked in place with a set screw.

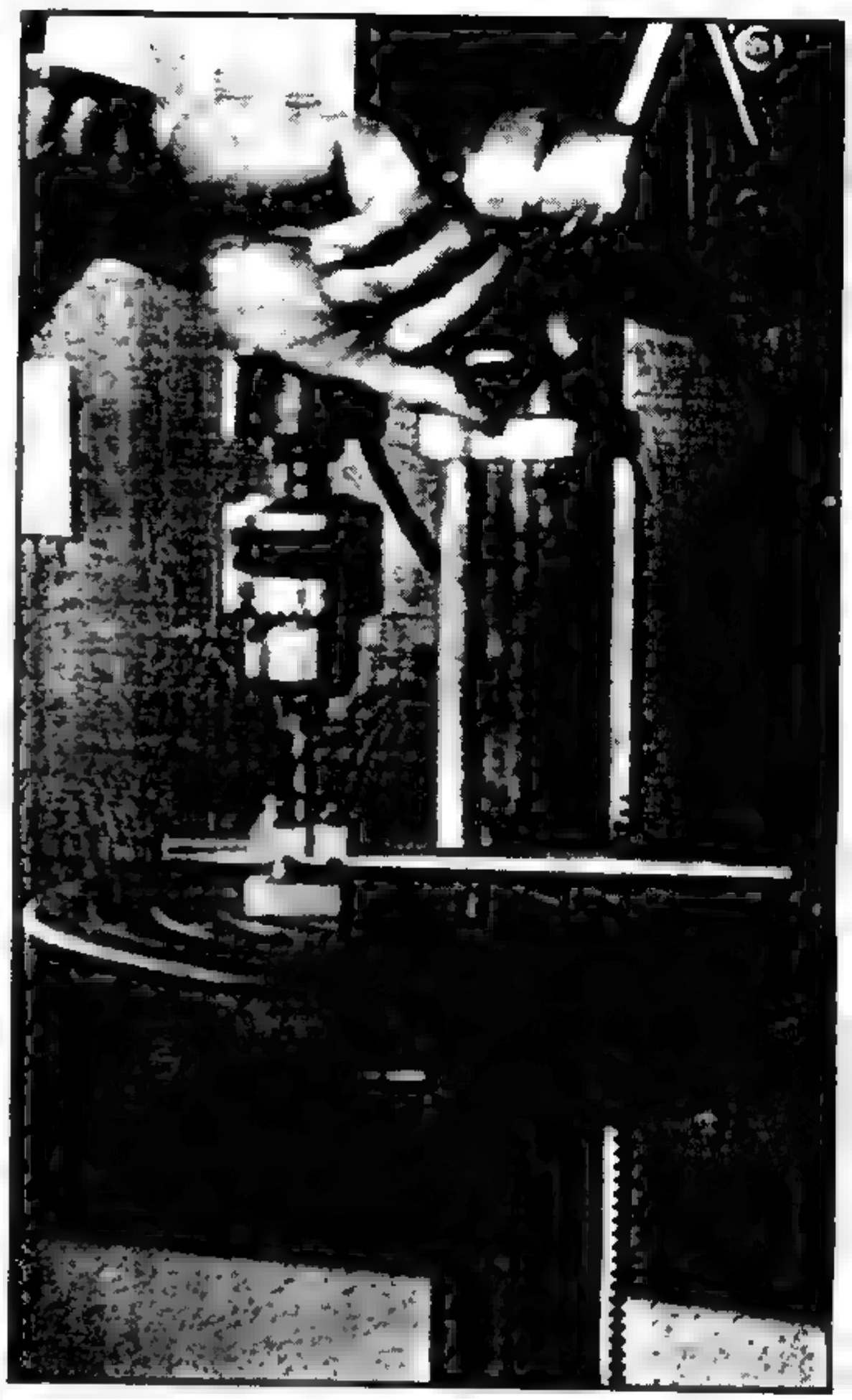
A barrel coupling is made to screw on to the end of the barrel which must be threaded to receive it and a sleeve then screwed into the front side of the barrel coupling until it butts against the muzzle end of the barrel. The muzzle cap, in turn, screws onto the end of the sleeve supporting and securing the outer tubes in place in the same fashion as the pistol installation.



Coupling and sleeve are then connected to barrel.



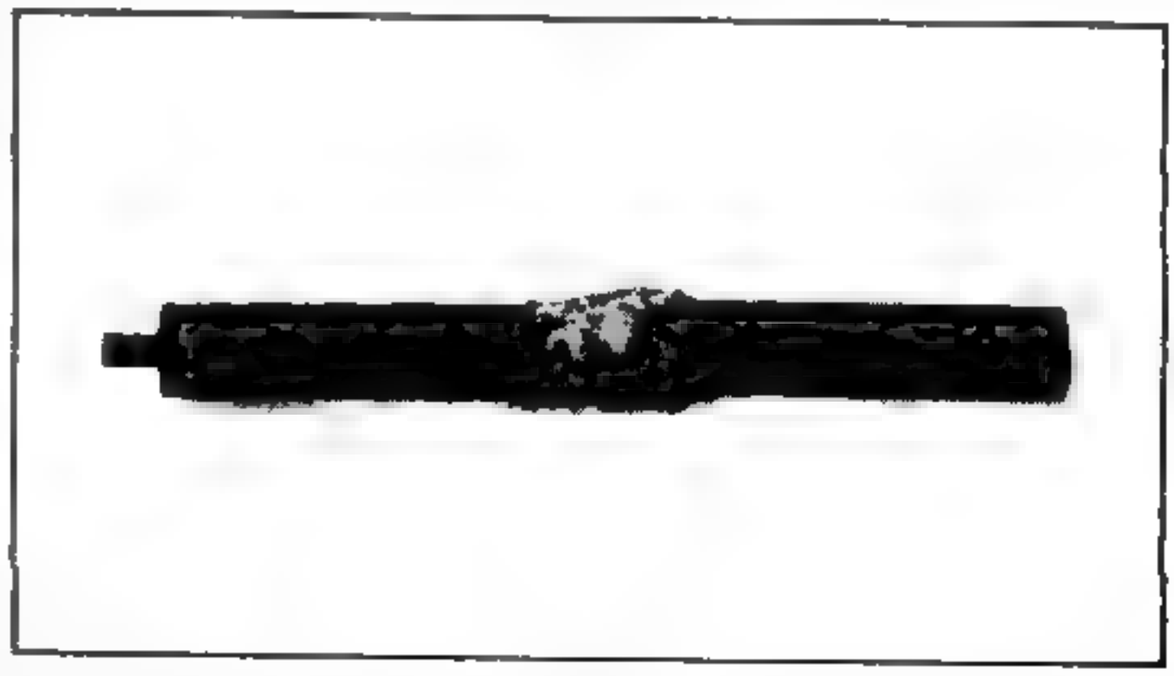
The first hole in the process of drilling. Hole is drilled entirely through sleeve thereby producing both top and bottom row at the same time, with but a single operation.



After the first two holes are drilled, the clamp is loosened, the sleeve slid forward until the last hole drilled is in line with the first hole in the jig. a locating pin inserted to keep it aligned and the clamp retightened. Another hole can now be drilled through the second hole in the jig. This process is repeated until the operation is completed.

The sleeve, in this instance, is five inches long. Here again, a shot-out or discarded military rifle barrel section can be used. The inside diameter, assuming the 9 mm Luger or Parabellum cartridge is used, should be .358"–.362". Four parallel rows of 5/16" (.3125") holes, spaced ½" center to center, should be drilled before the finished inside diameter is reamed and lapped.

Four rows of 5/16" holes spaced ½" apart are also drilled into the barrel. Actually, only two rows are required (I should have mentioned this earlier) since the drill can go in at the top, through the bore, and out the



Insulation is then rolled around the sleeve and front outer tube pushed over it.

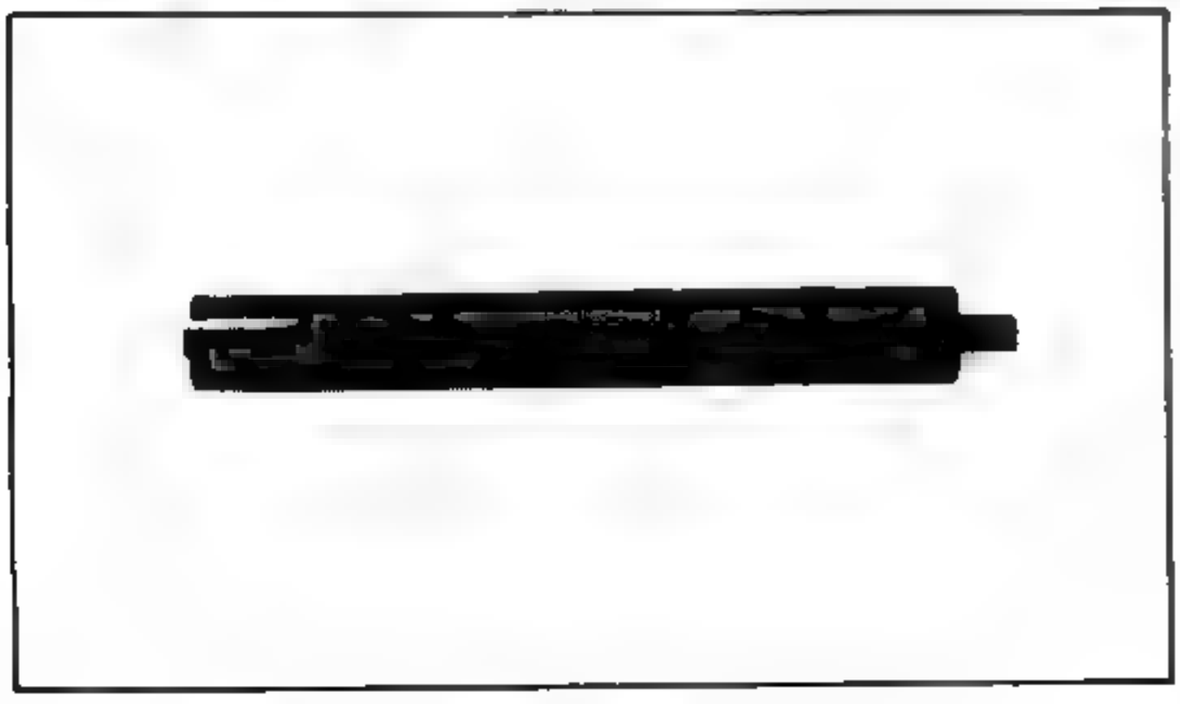
The drill jig showing use with a hand drill. The jig should be bolted to something solid when used in this manner.

bottom side, thereby drilling two holes with but a single operation. These holes should begin approximately 1 ½" forward of the chamber and end just behind the barrel coupling.

Burrs will be thrown up inside the bore by the drill's entry and exit into and out of the bore. Therefore, it will be necessary to lap the rifled portion after the ports are drilled by casting a lead lap around a steel rod as described in the barrel making chapter of Volume One of this series. The occurrence of these burrs can be greatly reduced by pouring the bore full of molten lead before the ports are drilled and driving the lead core out with a close-fitting rod after the drilling is complete.

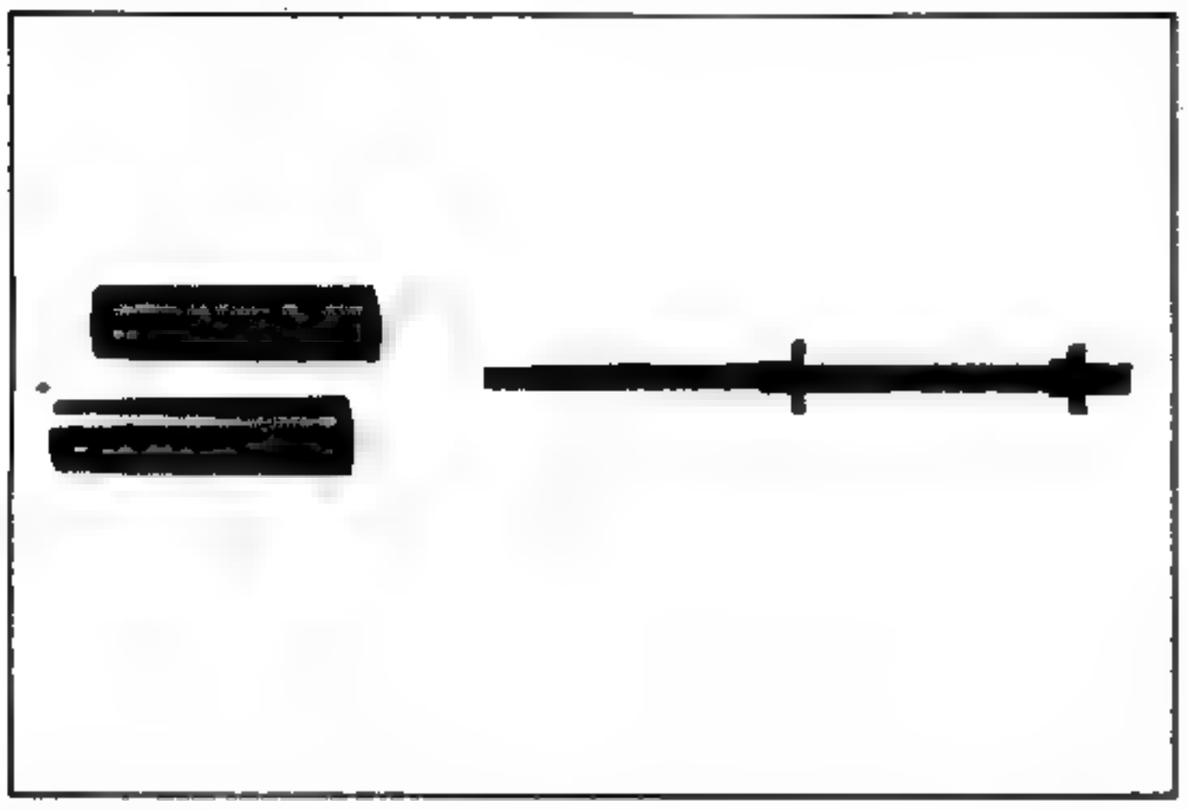
Drilling with a hand drill can be made much easier and more precise by constructing a simple drill jig as shown in the drawing and photographs. This jig is simply a pair of Vee blocks bolted together, with a pair of holes located with the same spacing as the holes you intend to drill intersecting the center line of the top Vee block.

SMG Barrel with barrel bushing and coupling in place.



The assembled silencer ready for installation.

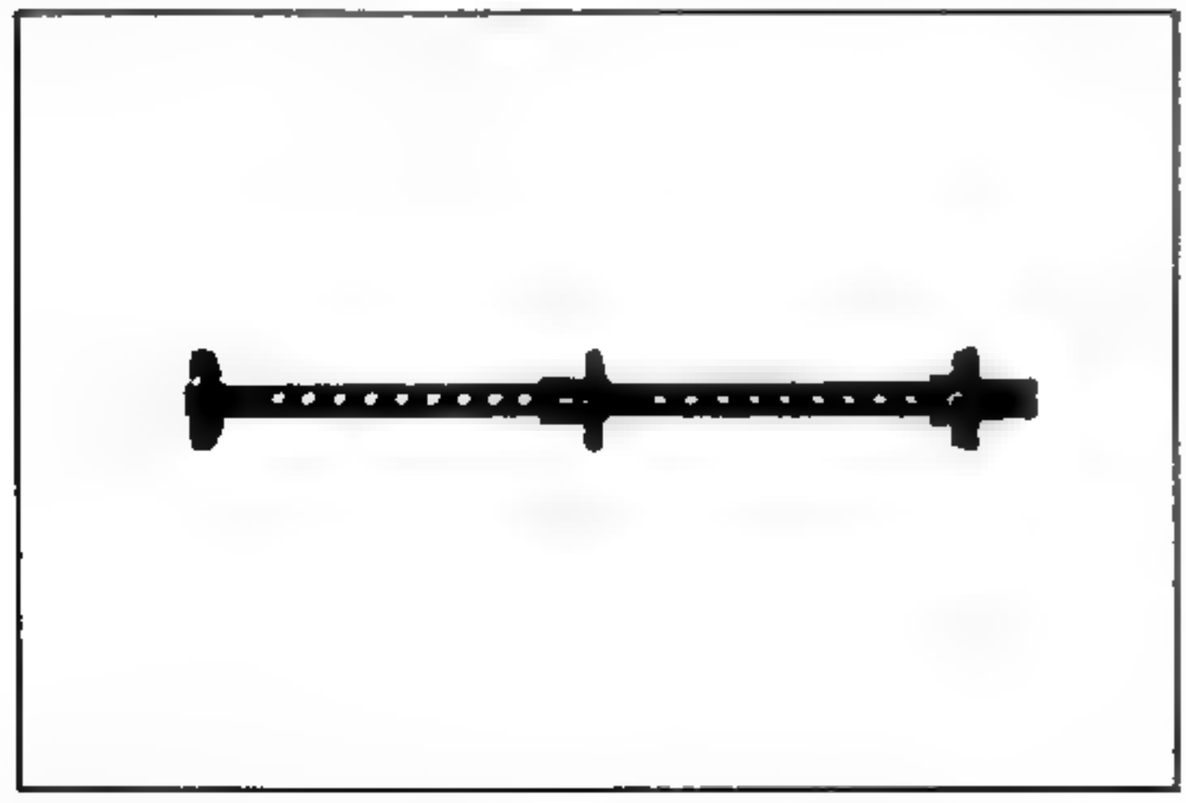
In practice, the sleeve in which the holes are to be drilled is clamped between your Vee blocks with the drill holes properly located to drill the first two holes. After these are drilled, the sleeve is slid forward or back until only one hole in the sleeve is lined up with the front hole in the jig. A locating pin of the same size as the drilled hole is pushed through both the jig opening, thus locating the holes the same exact distance apart and precisely in line. This process is repeated, one hole at a time, until the row is completed, at which time the sleeve is rotated 90 degrees and the process repeated.



SMG silencer components: outer tubes and muzzle cap not installed.

Discarded shock absorbers are again the source of material for the outer tubes. This time the outside housing of two shocks are used (two outer tubes are used) by cutting to the proper length and facing the ends square smooth. The ones I used had an inside diameter of 1.750" and an outside diameter of 1.850". Here again, if the tubes that you use are of a slightly different size, the coupling bushing and end cap diameter must be adjusted accordingly.

This silencer is assembled practically the same way as the pistol silencer, except that after the barrel bushing is secured in place on the chamber end of the barrel, a tightly wound roll of screen is placed around the barrel and the rear outer tube slipped over it, the rear end slipping over and against the shoulders of the barrel bushing. The barrel coupling is now screwed onto the end of the barrel, thus securing the outer tube in place. The sleeve is now screwed into the forward end of the barrel coupling, a roll of fiber glass insulation wound tightly around it, and the front outer tube slipped over it. The end cap is now screwed tightly in place, which in turn locates and holds the outer tube between the shoulders on the barrel coupling and the end cap.



SMG barrel and sleeve assembled with bushing, coupling and muzzle cap in place.

The unit is now ready to test fire, using the same precautions described earlier.

While the designs shown here are meant to be used on my own weapons designs, there is no reason why they cannot be adapted to other suitable weapons. On rifles and pistols where most, or all, of the barrel is exposed, the vent holes can be drilled in the barrel proper, a rear and center bushing installed on the barrel, and the muzzle end of the barrel threaded to receive an end cap which would secure the entire assembly in place. Where an installation is desired on a weapon which has the barrel partly or totally enclosed, the muzzle end of the barrel would be threaded to receive a barrel coupling as shown in the pistol design. The thread diameter might have to be slightly different; otherwise, the same dimensions should suffice.

We read about and see little sketches, etc., of silencers clamped and sometimes even taped to rifle and pistol barrels, made from tin cans, copper tubing, and the like. These are seldom, it ever, satisfactory. Such a flimsy, haphazard fabrication is usually only a figment of someone's imagination and has no practical value. While it is true that the designs shown here require a little bit of machine work and perhaps a day's time to build one, the result, if properly done, will be a sturdy, rigid assembly that will remain in line with the bore and not shoot loose. Then, too, these units can be repacked with new screen and insulation rolls time after time, thus restoring them to new condition over and over again. It would seem to me that the extra effort required is worthwhile.

In closing, let me say once more that unless you plan to assassinate someone, you very probably don't have any business with either of the units described here. The Federal Goverment has a number of penitentiaries scattered around the country just waiting for people that they catch with something like what is described in this book. Don't let them catch you.

Bill Holmes
Fayetteville, Arkansas 1980

FM 5-31

DEPARTMENT OF THE ARMY FIELD MANUAL

BOOBYTRAPS

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1965

FIELD MANUAL
No. 5-31

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *14 September 1965*

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CHAPTER 1

CHARACTERISTICS OF BOOBYTRAPS

Section I. INTRODUCTION

1. Purpose and Scope

a. This manual contains procedures techniques, and expedients for the instruction of the soldier in the assembly, use, detection, and removal of boobytraps in combat

b. Included are descriptions and discussions of the design and functioning characteristics of standard demolition items — firing devices, explosives, and accessories — and missiles, such as hand grenades, mortar ammunition, artillery ammunition, and bombs.

c. This manual also contains information on a variety of items and indigenous materials useful for improvising firing devices explosives, and pyrotechnic mixtures for guerrilla warfare applications.

d. Factory-produced boobytraps (dirty trick devices) are described. Most of these have been developed and used in the field by foreign armies

e. Safety measures pertinent to boobytrapping operations are provided for the protection of troops from casualty

f. The contents of this manual are applicable to nuclear and non-nuclear warfare

2. Comments

Users of this manual are encouraged to forward comments or recommendations for changes for improvement. Comments should be referenced to the page, paragraph, and line of text. The reason for each comment should be given to insure proper interpretation and evaluation. Forward all comments directly to the Commandant, U.S. Army Engineer School, Fort Belvoir, Virginia 22060.

Section II. PRINCIPLES OF OPERATION

3. Types of Boobytraps

A boobytrap is an explosive charge cunningly contrived to be fired by an unsuspecting person who disturbs an apparently harmless object or performs a presumably safe act. Two types are in use improvised and manufactured. Improvised boobytraps are assembled from specially provided material or constructed from materials generally used for other purposes. Manufactured boobytraps are dirty trick devices made at a factory for issue to troops. They

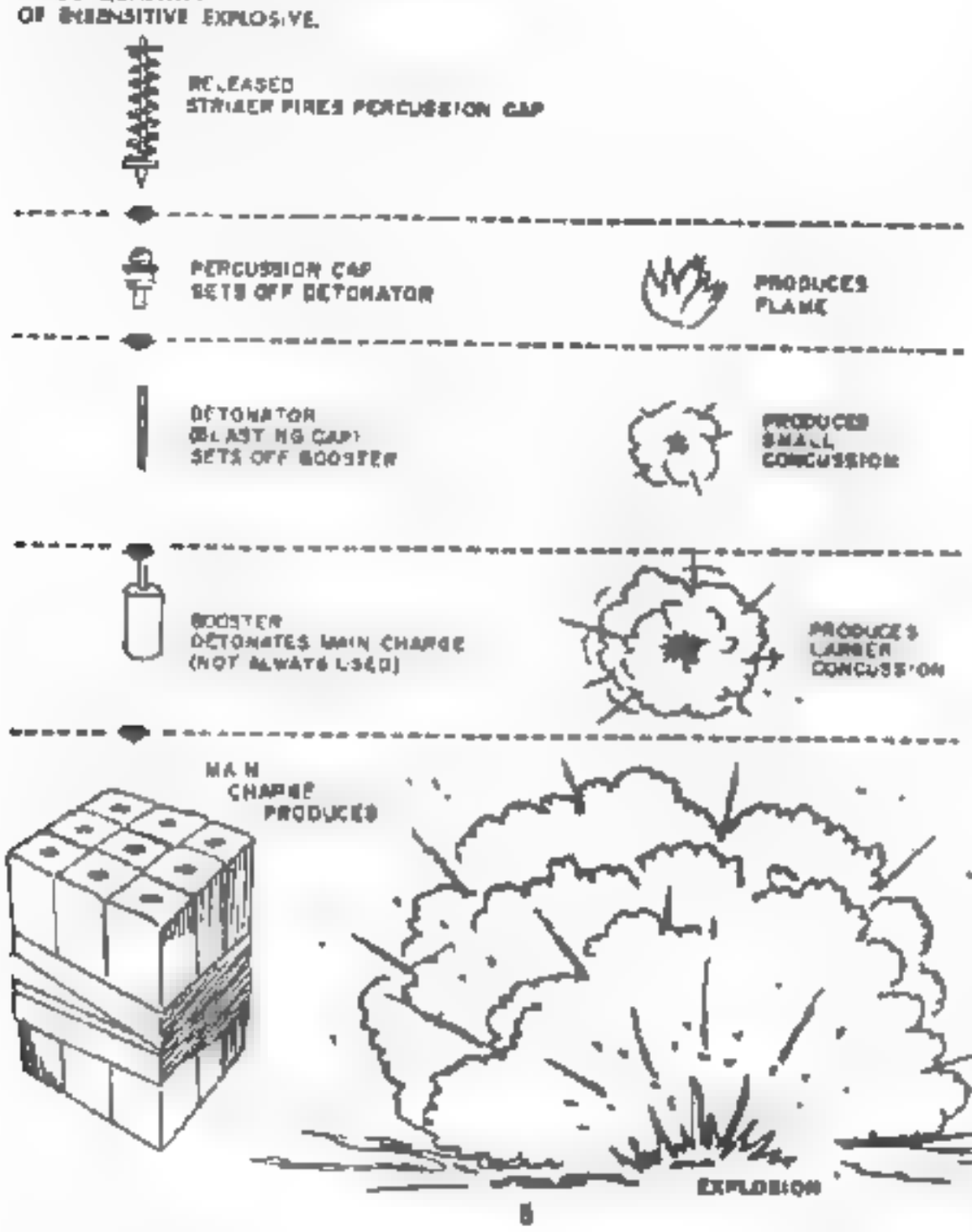
usually imitate some object or article that has souvenir appeal or that may be used by the target to advantage.

4

4. Assembling Boobytraps

A boobytrap consists of a main charge, firing device, standard base (not always used), and detonator. Another item, the universal destructor, is an adapter for installing a firing device assembly in a loaded projectile or bomb to make an improvised boobytrap. Also, firing device assemblies are often attached to the main charge by means of a length of detonating cord.

5. Boobytrap Firing Chain



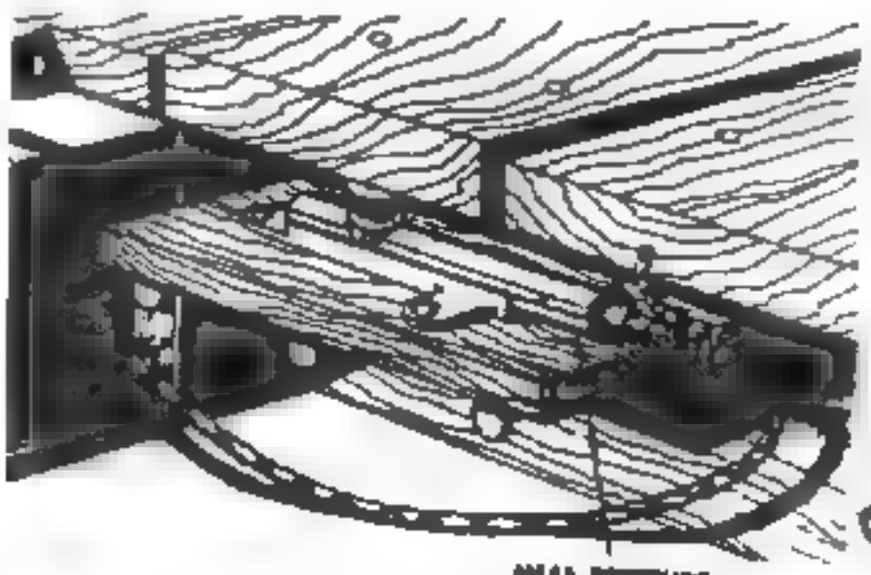
5

6. Initiating Actions

THE INITIATING ACTION STARTS THE SERIES OF EXPLOSIONS IN THE BOOBYTRAP FIRING CHAIN.

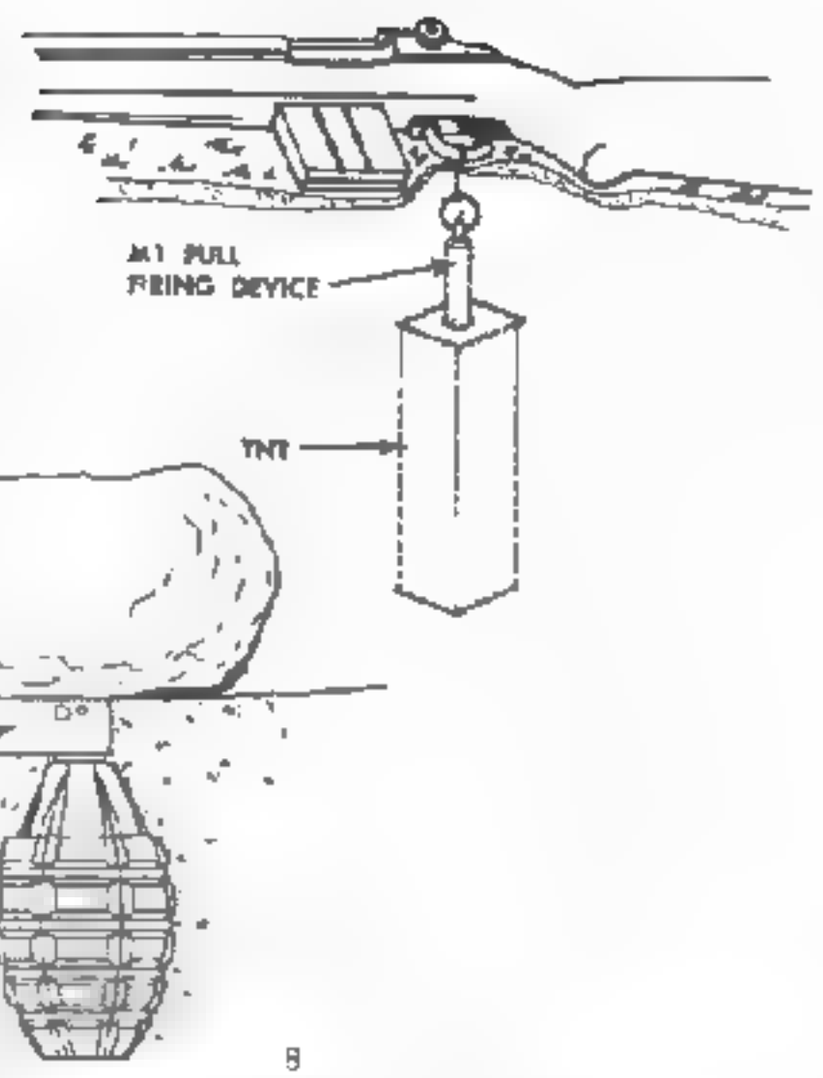
A. PRESSURE

WEIGHT OF FOOT STARTS EXPLOSIVE ACTION.



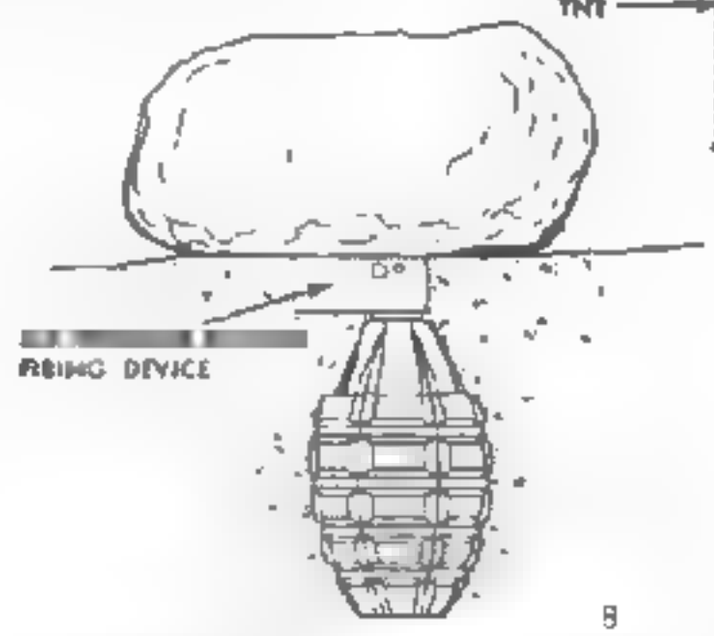
B. PULL

LIFTING THE SOUVENIR STARTS EXPLOSIVE ACTION.



C. PRESSURE RELEASE

MOVING THE STONE STARTS EXPLOSIVE ACTION.



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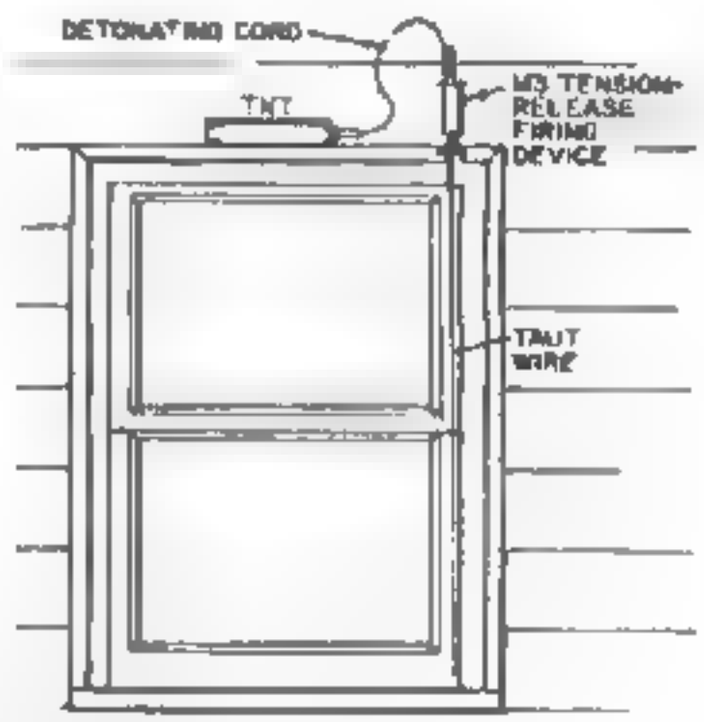
D. TENSION-RELEASE

RAISING LOWER SASH STARTS EXPLOSIVE ACTION.

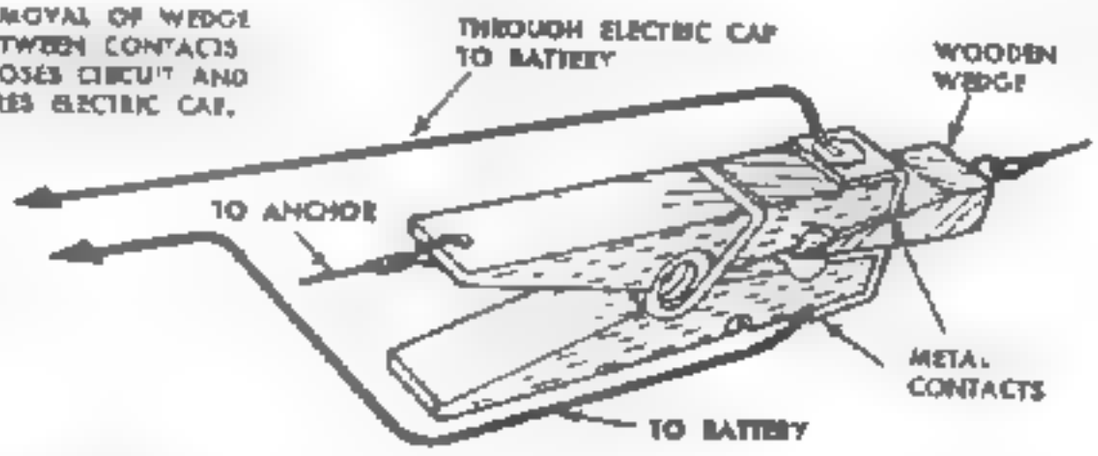


7. Firing Device Internal Actions

A FIRING DEVICE, WHEN ACTUATED MAY FUNCTION INTERNALLY IN MANY WAYS TO INITIATE THE FIRING CHAIN.

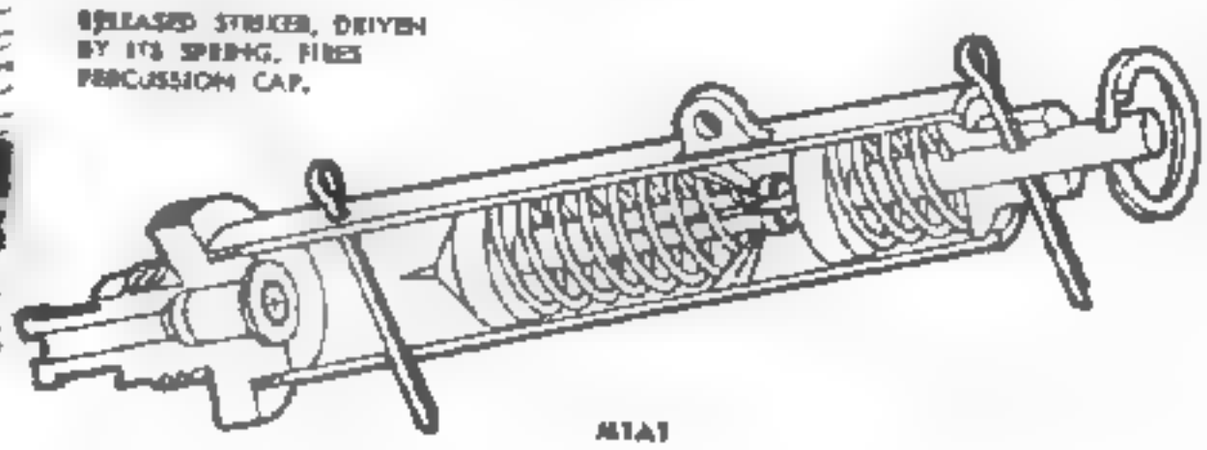
A. ELECTRIC

REMOVAL OF WEDGE BETWEEN CONTACTS CLOSES CIRCUIT AND FIRES ELECTRIC CAP.



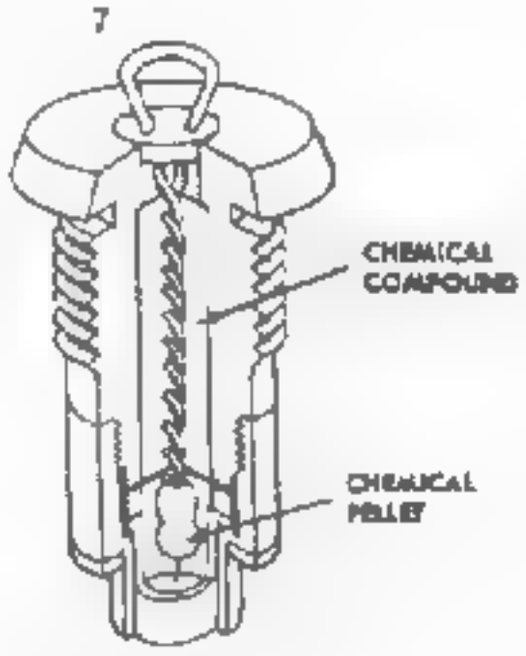
B. MECHANICAL

RELEASED STRIKER, DRIVEN BY ITS SPRING, FIRES PERCUSSION CAP.



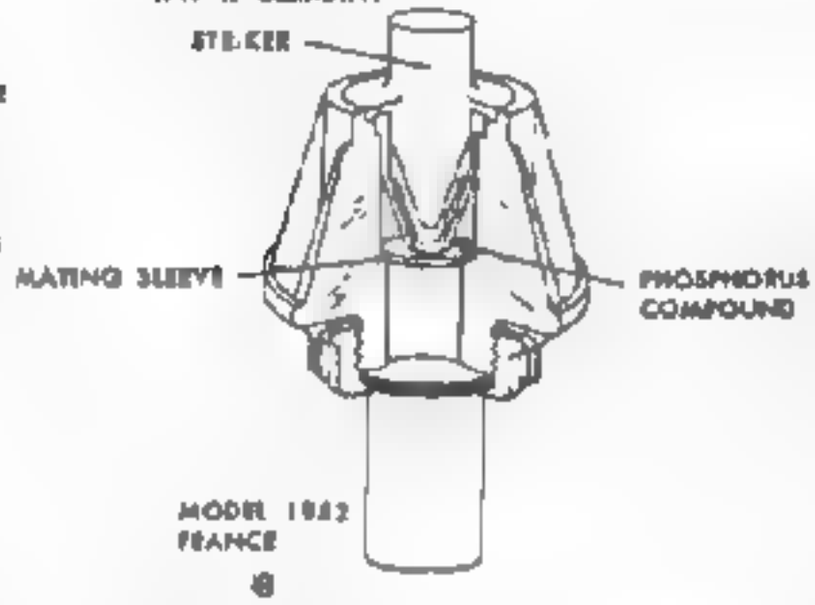
M1A1

C. FULL-FRICTION
PULLING THE CHEMICAL PELLET THROUGH THE CHEMICAL COMPOUND CAUSES FLASH THAT FIRES THE DETONATOR.

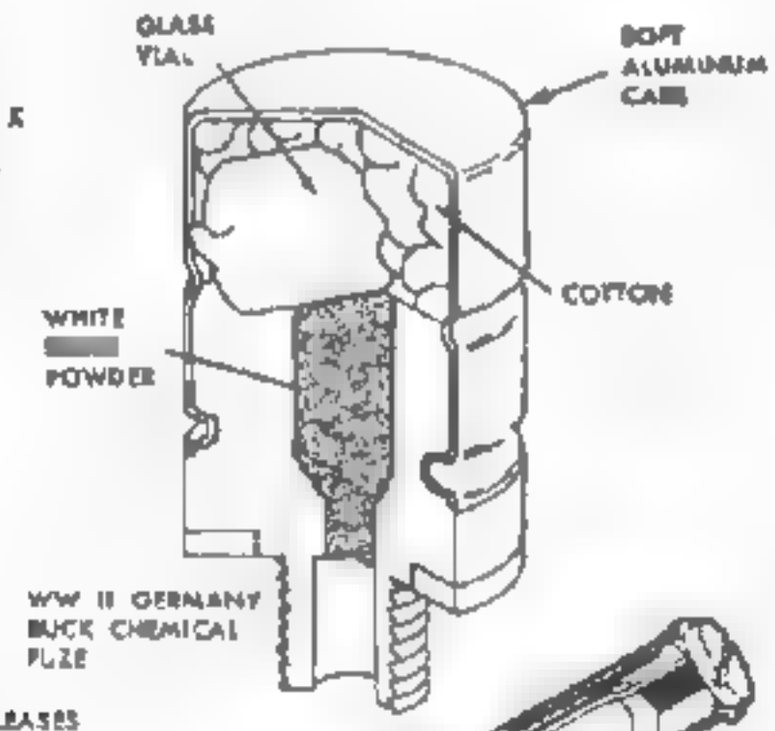


FULL FRICTION FUZE WEST WW II GERMANY

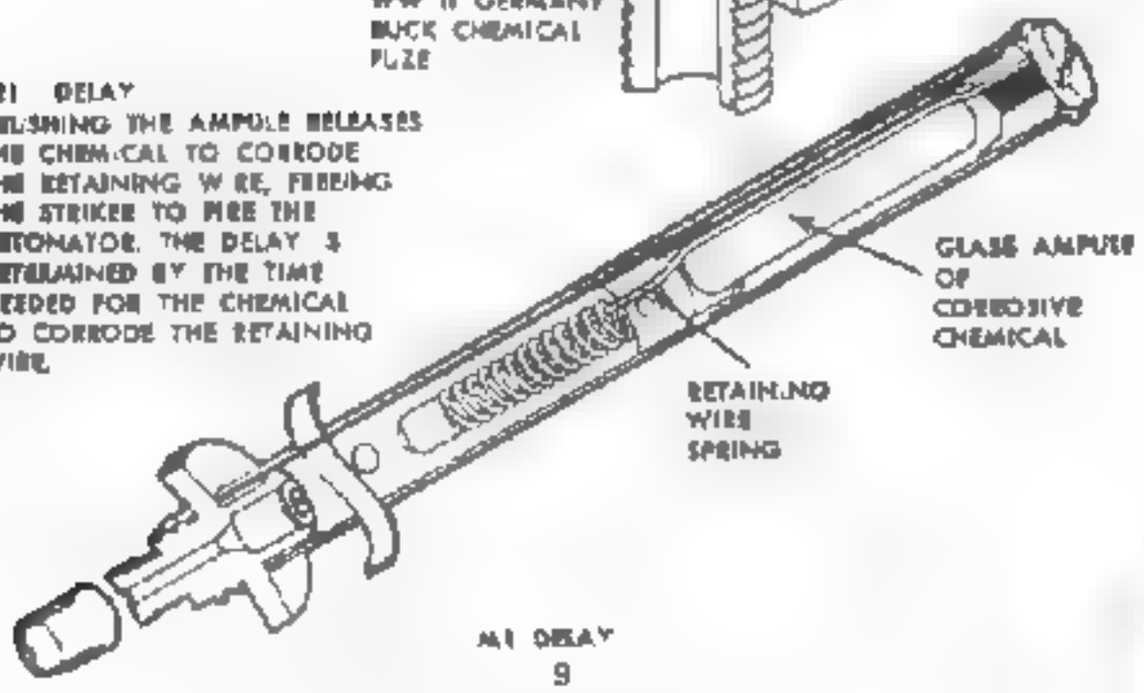
D PRESSURE-FRICTION
PRESSURE ON TOP OF THE STRIKER FORCES ITS CONE-SHAPED END INTO [redacted] GLASS MIXTURE IN THE MATING SLEEVE, CAUSING A FLASH THAT FIRES THE DETONATOR



E. CHEMICAL
(1) PRESSURE
PRESSURE ON THE TOP BREAKS THE VIAL, FREEING THE SULPHURIC ACID TO MIX WITH THE FLASH POWDER, PRODUCING A FLAME THAT FIRES THE DETONATOR.



(2) DELAY
CRUSHING THE AMPULE RELEASES THE CHEMICAL TO CORRODE THE RETAINING WIRE, FREEING THE STRIKER TO FIRE THE DETONATOR. THE DELAY IS DETERMINED BY THE TIME NEEDED FOR THE CHEMICAL TO CORRODE THE RETAINING WIRE.



M1 DELAY

CHAPTER 2

USE OF BOOBYTRAPS

Section I. BASIC DOCTRINE

8. Tactical Principles

Boobytraps supplement minefields by increasing their obstacle value. They add to the confusion of the enemy, inflict casualties, destroy material, and lower morale. Boobytraps are usually laid by specialists. All military personnel, however, are trained in handling explosives and other boobytrapping material, so that they may, if necessary, boobytrap a mine or install a simple boobytrap.

9. Authority

a. Army commanders issue special instructions for the use of boobytraps within their command. Supplies are authorized and provided as required to meet boobytrapping needs.

b. Army and higher commanders may delegate authority to lay boobytraps to as low as division commanders. All higher commanders, however, may revoke this authority for a definite or indefinite period, as the tactical situation may require.

c. Records of all boobytraps laid are prepared and forwarded to higher headquarters.

d. Enemy boobytraped areas, as soon as discovered, are reported to higher headquarters to keep all interested troops advised of enemy activities. If possible, all boobytraps are neutralized; otherwise they are properly marked by warning signs.

Section II. PLANNING

10. Tactical Effects

a. The ingenious use of local resources and standard items is important in making effective boobytraps. They must be simple in construction, readily disguised, and deadly. They may produce unexpected results if conceived in sly cunning and built in various forms. Boobytraps cause uncertainty and suspicion in the mind of the enemy. They may surprise him, frustrate his plans, and inspire in his soldiers a fear of the unknown.

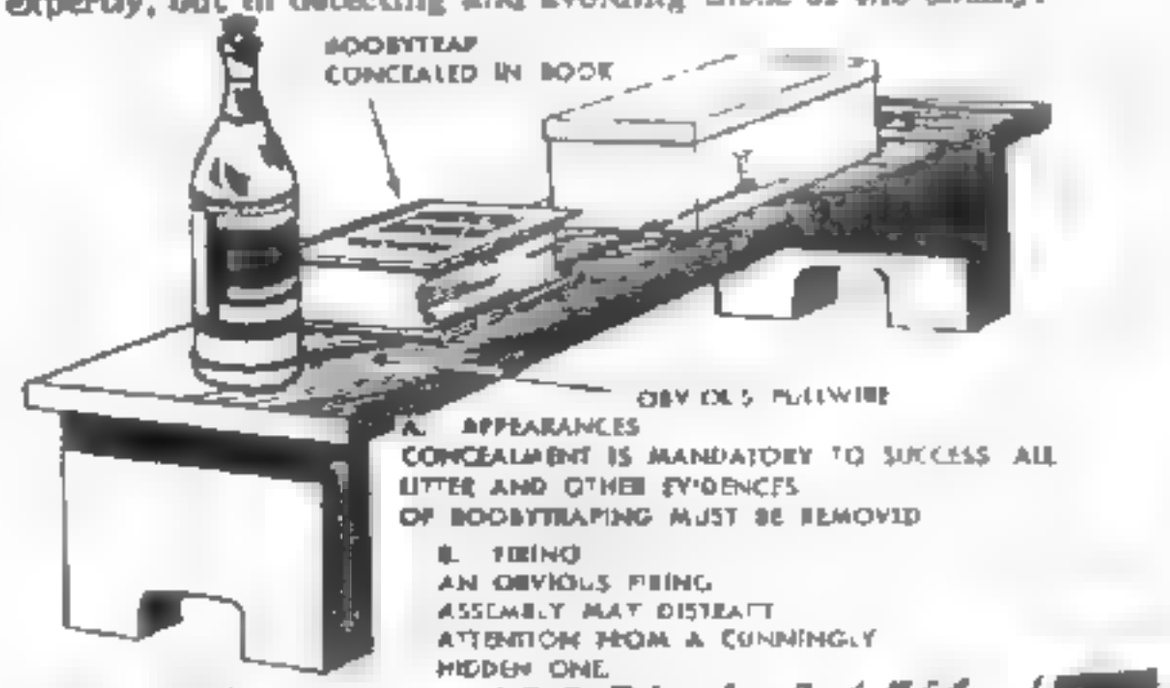
b. In withdrawal, boobytraps may be used in much the same way as nuisance mines. Buildings and other forms of shelter, roads, paths, diversions around obstacles, road blocks, bridges, fords, and similar areas are suitable locations for concealing boobytraps.

c. In defense, boobytraps, placed in the path of the enemy at strategic locations in sufficient numbers, may impede his progress, prevent detailed reconnoissance and delay disarming and removal of minefields.

[redacted]

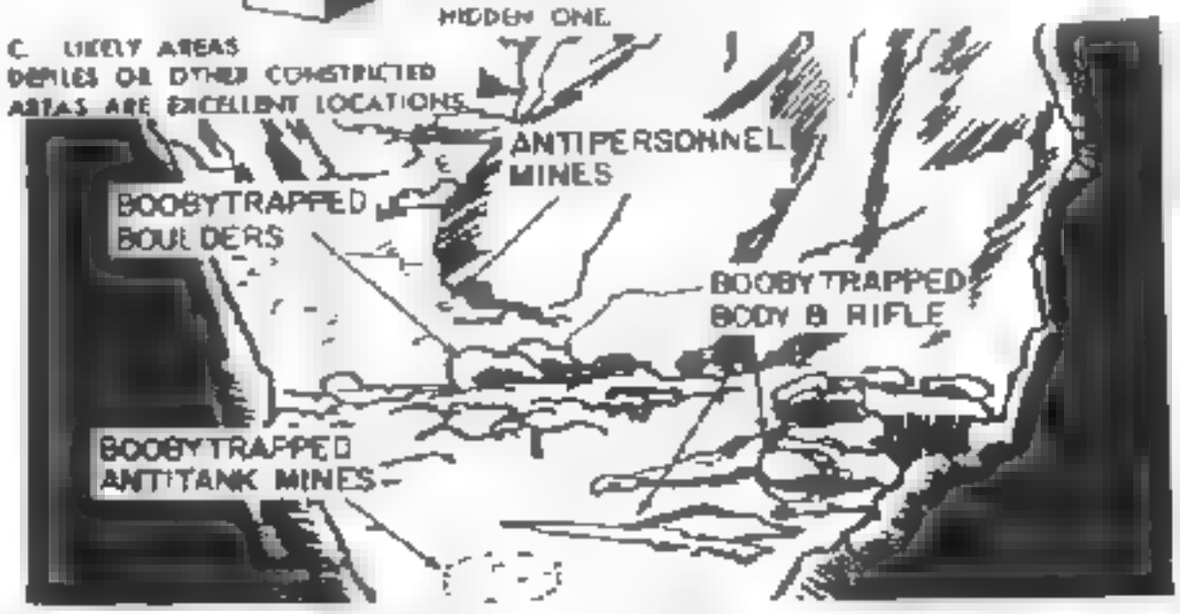
11. Basic Principles

Certain basic principles, as old as warfare itself, must be followed to get the optimum benefit from boobytraps. Knowledge of these principles will aid the soldier, not only in placing boobytraps expertly, but in detecting and avoiding those of the enemy.



A. APPEARANCES
CONCEALMENT IS MANDATORY TO SUCCESS. ALL LITTER AND OTHER EVIDENCES OF BOOBYTRAPING MUST BE REMOVED

B. TIMING
AN OBVIOUS FIRING ASSEMBLY MAY DISTRACT ATTENTION FROM A CUNNINGLY HIDDEN ONE.



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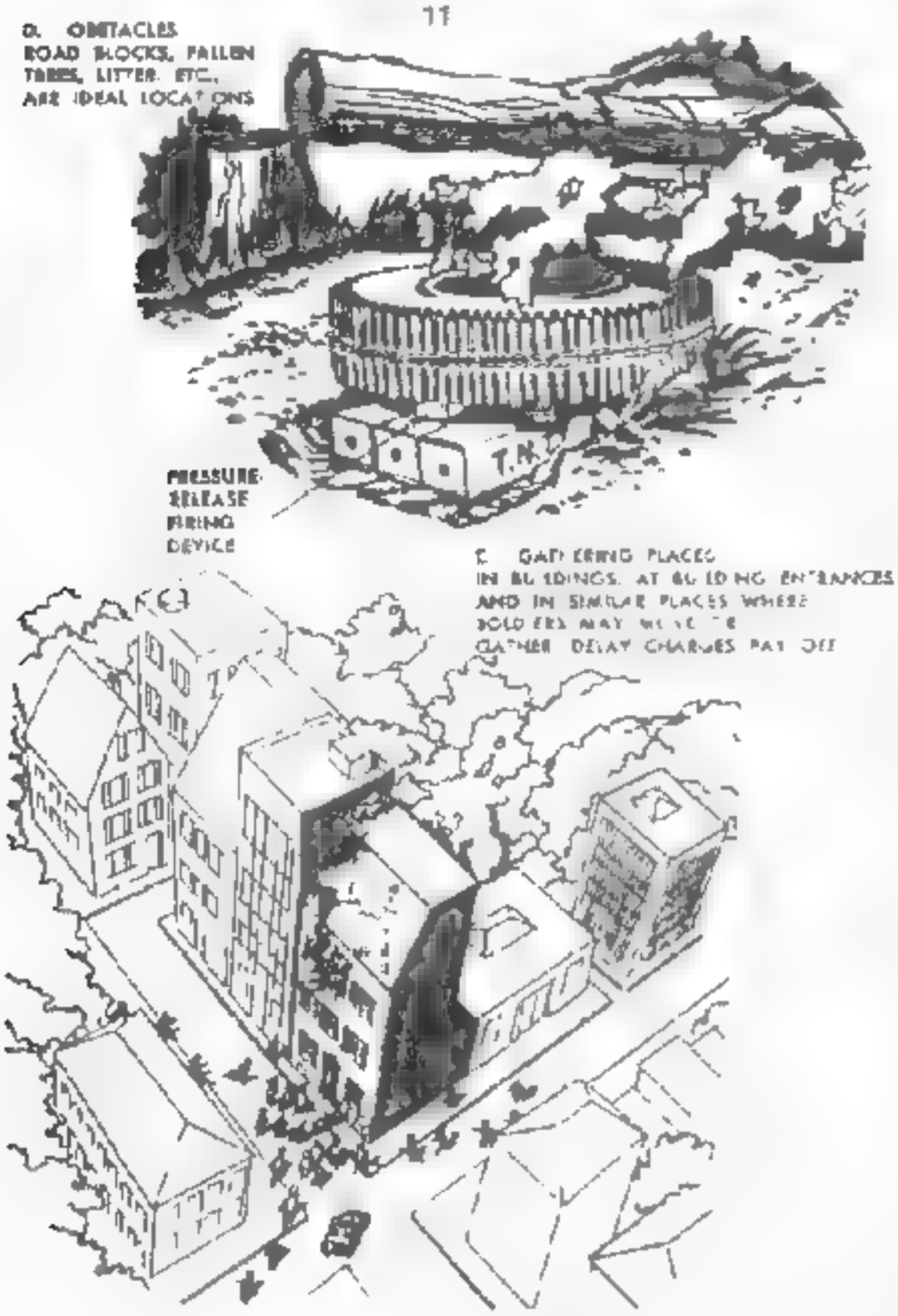

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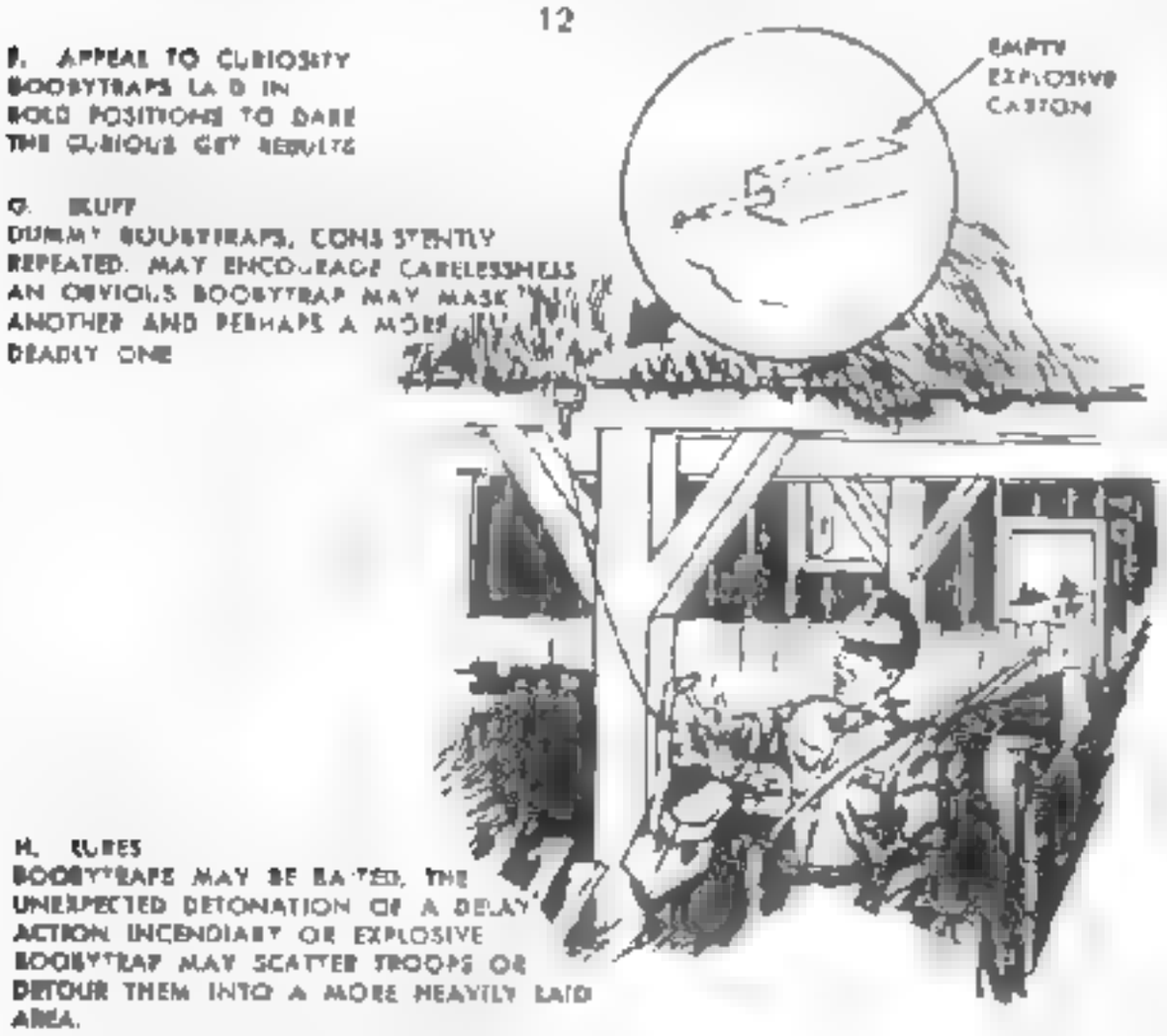

12. Location of Charges

a. Preparation. Small compact boobytraps are the most desirable for use in raids in enemy-held territory. Each member of a team must carry his own supplies and be able to operate independently. Boobytraps should be assembled except for the attachment of the firing device, before entering enemy territory. Thus will reduce the work at the site to the minimum.

b. Location. Charges should be placed where they will do the most damage. A charge detonated against a stone wall will expend its force in magnified intensity away from the wall. The force of an explosion on the ground will affect the surrounding air more if the charge is placed on a hard surface. This deflects the explosive wave upward. A charge detonating 6 to 10 feet above the ground will damage a larger area than one laid on or below the surface.

c. Characteristics. Many inexpensive boobytraps, simple to make and easy to lay, will delay and confuse the enemy more than a small number of the expensive and complex kind. Complex mechanisms

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cost more, require more care in laying, and offer little more advantage than the simple type.

13. Reconnaissance

Complete reconnaissance of an area is essential to good planning. Without this and the preparation of a program, boobytraps may not be used effectively. Boobytrap teams are best suited to survey a combat area to determine its boobytrapping possibilities.

14. Plan of Operation

a. The commander with authority to use boobytraps coordinates his plans with other tactical plans. Timing of boobytrap operations with movement plans is extremely essential. Boobytraps should not be laid in areas where friendly troops will remain for any appreciable length of time. Plans will indicate what is to be done, where and when it will be done, and the troops to be used. Generally, trained troops are assigned such tasks.

b. The plan authorizes the use of boobytraps and the types and densities required in specified areas, depending on the terrain, time, personnel, and material available. The completion of the detailed plan is delegated to the commander responsible for installation. Materials are obtained from unit supply stocks on the basis of the proposed action.

c. Complete coordination between the troop commander and the officer supervising boobytrap activities is essential. The area should be evacuated immediately following the completion of the job.

d. The commander installing boobytraps prepares a detailed plan indicating the site and the location, number, type, and setting. He assigns boobytrap teams to specific areas and the laying of specified types. The plan covers arrangements for supplies and transportation and designates the location where all preliminary work on boobytraps will be done. Time tables are established to insure completion of the work to comply with withdrawal phases of tactical plans.

e. In hasty withdrawal, when there is no time for planning, each team will be given a supply of material with instructions for making the best possible use of it in the time allowed.

f. Boobytrap planning must give proper consideration to all known characteristics of the enemy. Members of teams should study the personal habits of enemy soldiers, constantly devising new methods to surprise them. Repetitions may soon become a pattern easily detected by an alert enemy.

g. Withdrawal operations are the most desirable of all for laying boobytraps. When an enemy meets a boobytrap at the first obstacle, his progress throughout the area will be delayed even though no others have been laid. A few deadly boobytraps and many dummies, laid indiscriminately, can inspire great caution. Dummies, however, should be unserviceable or useless items. Never throw away material that may return to plague friendly forces!

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Section III. INSTALLATION

15. Responsibilities

a. A commander authorized to use boobytraps is responsible for all within his zone of command. He will keep adequate records showing their type, number, and location, and prepare information on those laid and on practices followed by the enemy.

b. Management of boobytrap services may be delegated to the engineer staff officer.

c. Unit commanders must know the location of all boobytraps in their areas and keep all subordinates so advised. Subordinates are also responsible for reporting to higher headquarters all new information obtained on enemy boobytraps.

d. Officers responsible for laying boobytraps prepare plans, supervise preliminary preparations, and direct their installation. They forward to proper authority a detailed report of their progress, advise all concerned when changes are made, and report to engineer intelligence units the discovery of any new enemy devices or low-cunning practices

e. Engineer and infantry units, with special training, have the responsibility of installing and neutralizing boobytraps. Since adequate numbers of trainees may not always be available, all troops are given familiarity instruction in boobytrapping.

16. Procedures

Like all activities involving explosives, boobytrapping is dangerous only because of mistakes men make. Prescribed methods must be followed explicitly in the interest of personal safety and overall effectiveness.

a. Before assemblying a boobytrap, all components should be inspected for serviceability. They must be complete and in working order. All safeties and triggering devices must be checked to insure proper action, and for rust or dents that might interfere with mechanical action.

b. If a boobytrapping plan is not available, one must be prepared on arrival at the site, so that the material obtained will be required items only. A central control point should be established in each boobytrap area where supplies may be unloaded and from which directions may be given. In areas where many boobytraps are concentrated, safe passage routes from the control point to each location must be marked clearly. Lines or tape may be useful where vegetation is heavy. The control man is the key man.

c. Several teams may operate from one control point. Each team (rarely more than two men) is assigned to a specific area and supplies are issued only as needed. Each detail commander must make certain that every man knows his job and is competent to do it. Teams will remain separated so that one may not suffer from the mistake of another. When a job is completed, all teams

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must report to control man before going elsewhere.

d. One person in each team is designated leader to direct all work. If possible, members of a team will avoid working close together when a boobytrap is assembled. One member should do all technical work and the other be a helper to carry supplies, provide assistance needed, and learn the skills needed

e. Boobytraps laid during raids into enemy held territory should be small, simple, and easily installed. Each member of a party must carry the supplies he needs. The use of boobytraps under these conditions, when accurate records are impossible, may be a hazard to friendly troops if raids into the same area should become neces-

[redacted]

f. Procedure for installing boobytraps is as follows:

(1) Select the site that will produce the optimum effect when the boobytrap is actuated.
(2) Lay the charge, then protect and conceal it.
(3) Anchor the boobytrap securely, with nails, wire, rope, or wedges, if necessary.
(4) Camouflage or conceal, if necessary.
(5) Teams arm boobytraps systematically, working toward a safe area.
(6) Leave the boobytrapped area clean. Carry away all items that might betray the work that has been done, such as loose dirt, empty boxes, tape, and broken vegetation. Obliterate footprints.

17. Reporting, Recording, and Marking

Boobytraps are reported and recorded for the information of tactical commanders and the protection of friendly troops from casualty. Boobytrap installations are reported and recorded as nuisance minefields, whether the area contains both boobytraps and mines or boobytraps alone.

a. Reports

(1) *Intent.* This is transmitted by the fastest means available consistent with signal security. It includes the location of the boobytrapped area selected, the number and type of mines to be laid (if antitank mines are boobytrapped), boobytraps to be laid, the estimated starting and completing time, and the tactical purpose. The report is initiated by the commander authorized to lay the field and forwarded to higher headquarters.
(2) *Initiation of Laying.* This report is transmitted by the fastest means available consistent with signal security. It contains the location and extent of the field, total number of mines and boobytraps to be laid, and estimated time of completion. The commander of the unit installing

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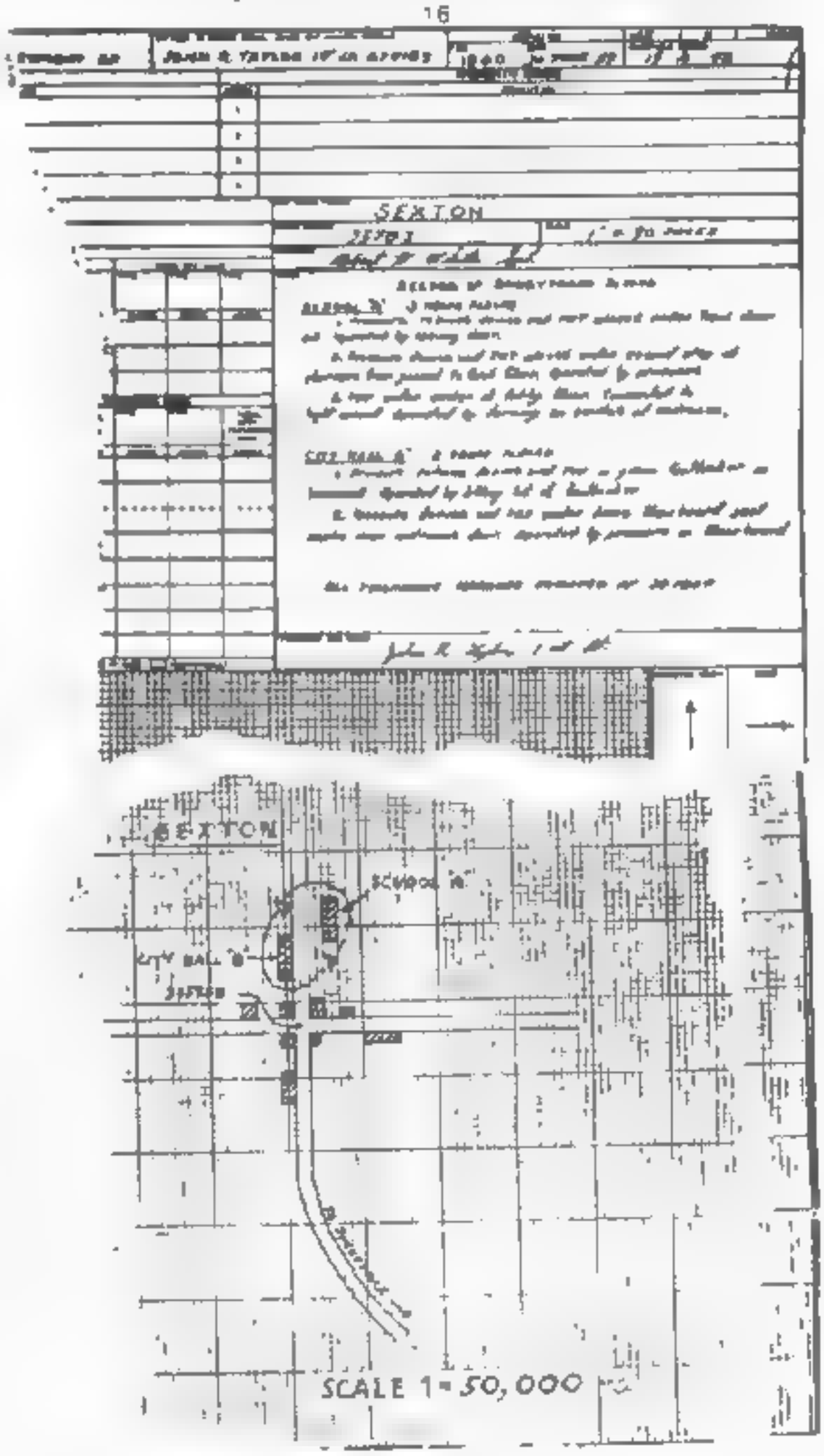

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the field sends the report to the commander that directed him to lay it.

(3) *Completion.* The report of completion is transmitted by the fastest possible means. It contains the number and

type of boobytraps laid, location and extent of the field or area and the time of completion. The report is forwarded to army level. When boobytraps are laid, either alone or with mines, the report of intent and the report of initiation of laying will include the estimated number of boobytraps to be placed and the report of completion, the number placed.

b. Records. Boobytraps are recorded as nuisance mine fields on the standard mine field record form. It is filled in as follows:

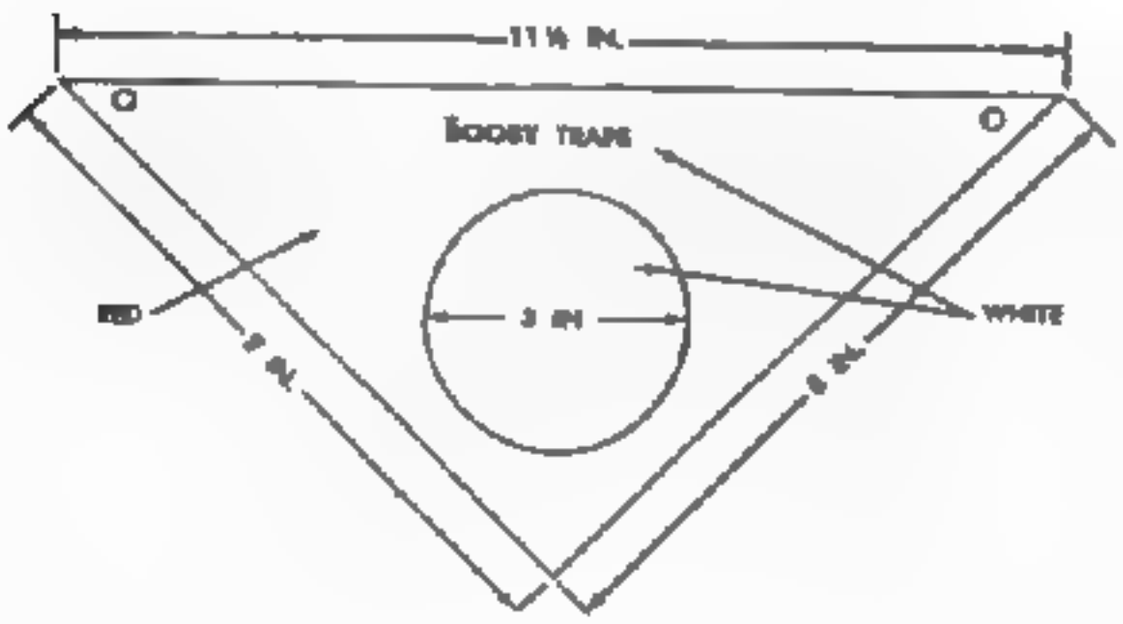
(1) The general locations are shown on the sketch, using the appropriate symbol. Boobytrapped areas or buildings are lettered aerially, "A" being the nearest to the enemy.

(2) The number, types, locations, and methods of operation of boobytraps are entered in the NOTES section of the form. If space is lacking, additional sheets may be attached. If the boobytrap cannot be adequately described in a few short sentences, a sketch of minimum details will be included.

(3) The record is prepared simultaneously with the laying of the boobytrap and forwarded through channels to army level without delay. If a standard form is not available, the data required must be entered and submitted on an expedient form.

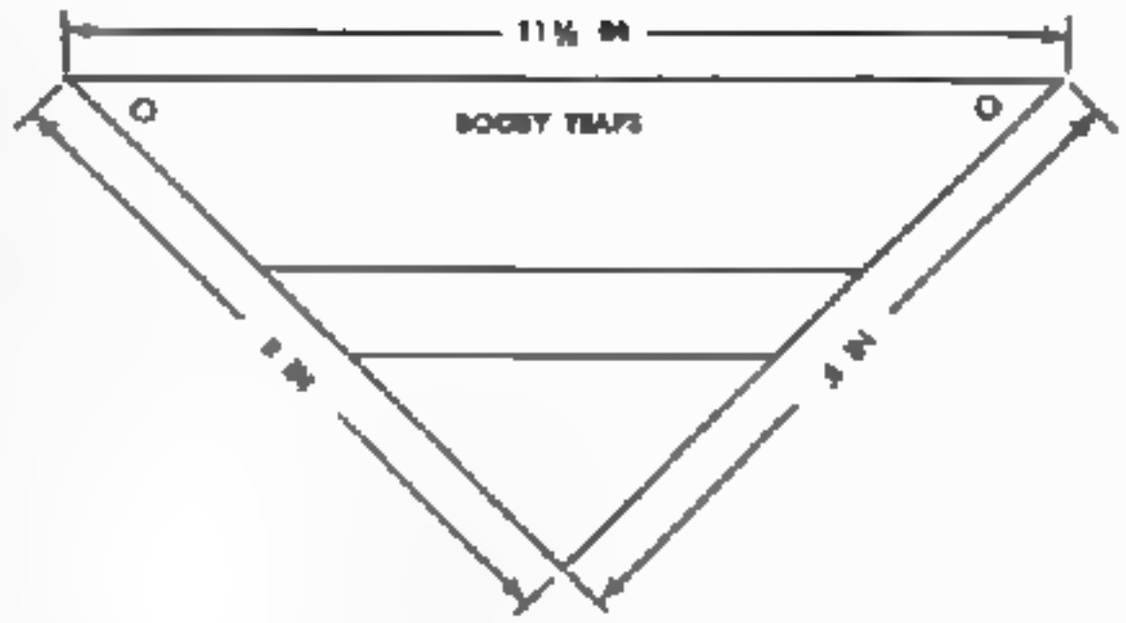
(4) Nuisance mine fields containing both mines and boobytraps are recorded as prescribed in FM 20-32. When the specific locations of boobytraps and manufactured devices cannot be accurately recorded(scattered laying in open areas) their number and type are entered in the notes section of the form and identified by grid coordinates.

c. Marking. Boobytraps are marked by special triangular signs painted red on both sides. On the side facing away from the danger area, a 3-inch diameter white disc, is centered in the triangle and the word BOOBYTRAPS is painted in white across the top in 1-inch letters. The STANAG or new sign is similar except for the 1-inch white stripe below the inscription. Signs may be made of metal, wood, plastic, or similar material. They are placed above ground, right-angled apex downwards, on wire fences, trees, or doors, windows, or other objects or by pushing the apex in the ground. These warning signs are used by all troops to identify friendly boobytraps during the period preceding withdrawal from an area, or to warn friendly forces of the presence of active enemy boobytraps.



d. Abandonment. When abandoning a boobytrapped area to the enemy, all markers, wire, etc., are removed.

e. Signs. Signs are also used to mark enemy boobytraps or boobytrapped areas.



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CHAPTER

BOOBYTRAPPING EQUIPMENT

Section I. FIRING DEVICES

18. Introduction

Many triggering devices are available for use in boobytraps. They include fuzes, igniters, and firing devices. All U.S. standard firing devices have the following advantages over improvisations; established supply, speed of installation, dependability of functioning, resistance to weather, and safety. All have a standard base coupling by which they may readily be attached to a variety of charges. For more detailed information see TM9-1375-200.

19. M1A1 Pressure Firing Device

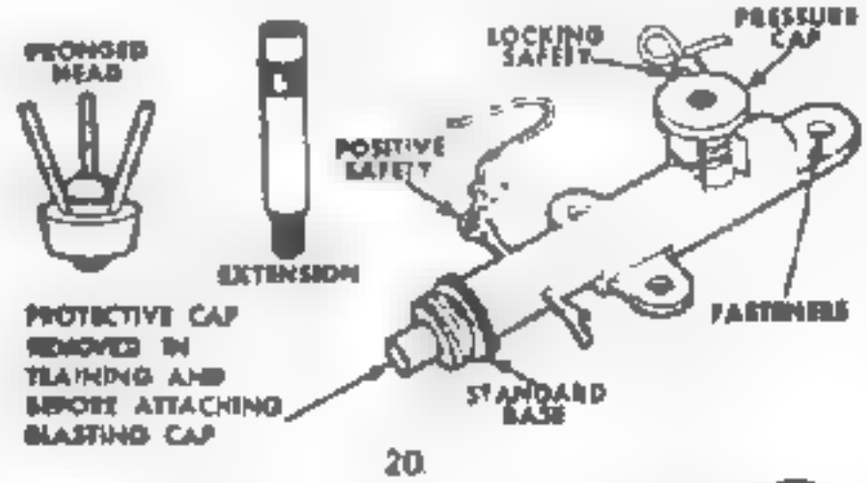
a. Characteristics.

Dimensions					
Case	Color	D	L	Internal Action	Initiating Action
Metal	Olive drab	⅝ in.	2⅝ in.	Spring driven striker with keyhole slot release	20 lb. pressure or more

Safeties	Accessories	Packaging
Safety clip and positive safety pin	3-pronged pressure head and extension rod	Five units with standard bases packed in cardboard carton. Thirty cartons shipped in wooden box.

b. Functioning.

A pressure of 20 pounds or more on the pressure cap moves the trigger pin downward until the striker spindle passes through the keyhole slot. This releases the striker to fire the percussion cap.



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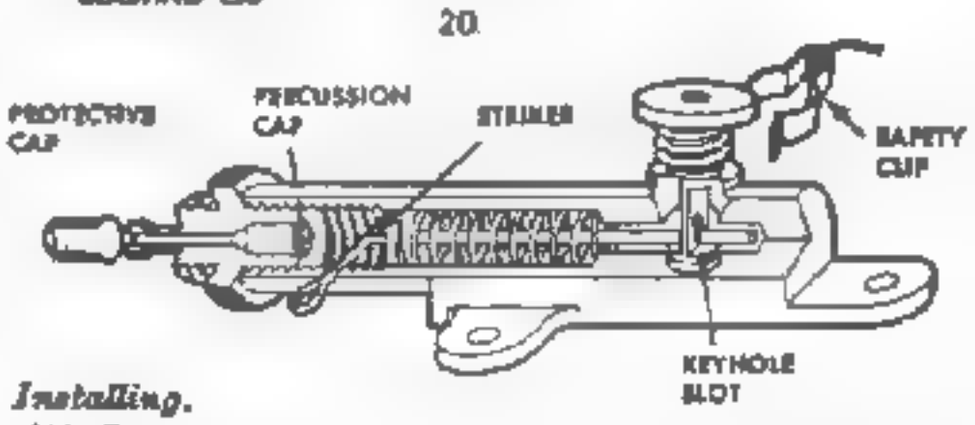
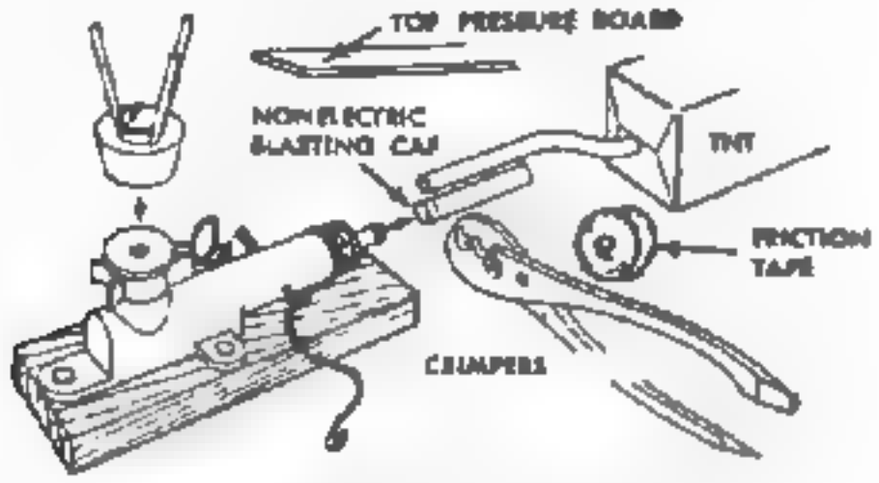


c. Installing.

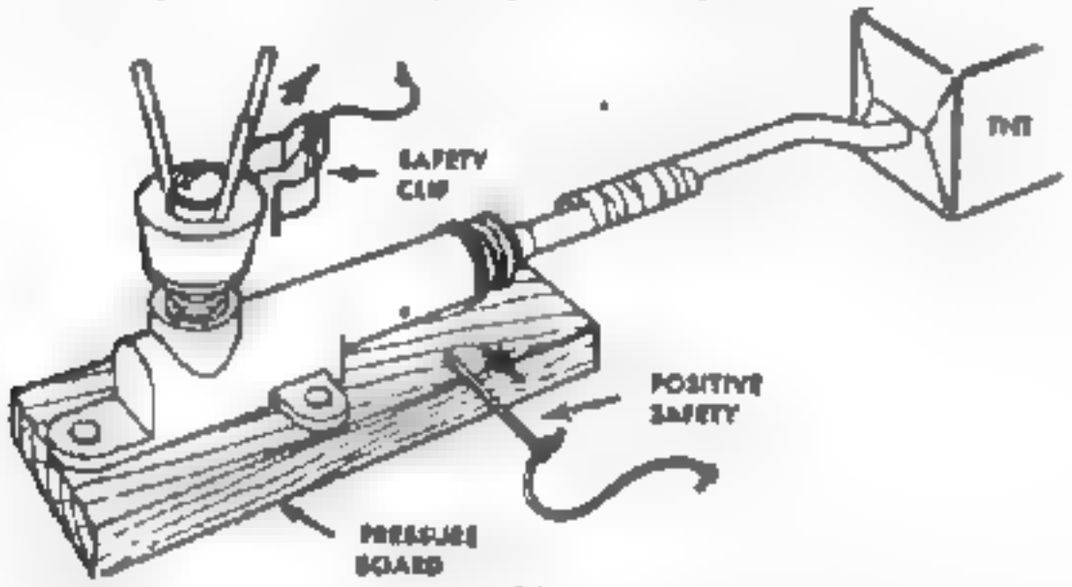
(1) Remove protective cap from base and crimp on a nonelectric blasting cap. *Crimper jaws should be placed no farther than ¼ inch from open end of blasting cap.*

(2) Assemble 3-pronged pressure head and extension rod and screw in top of pressure cap, if needed.
(3) Attach firing device assembly to standard base.
(4) Attach firing device assembly to charge.



NOTE. If top pressure board is used, allow clearance space between it and top of primer or pressure cap.

d. Arming. Remove safety clip first and *positive pin last.*



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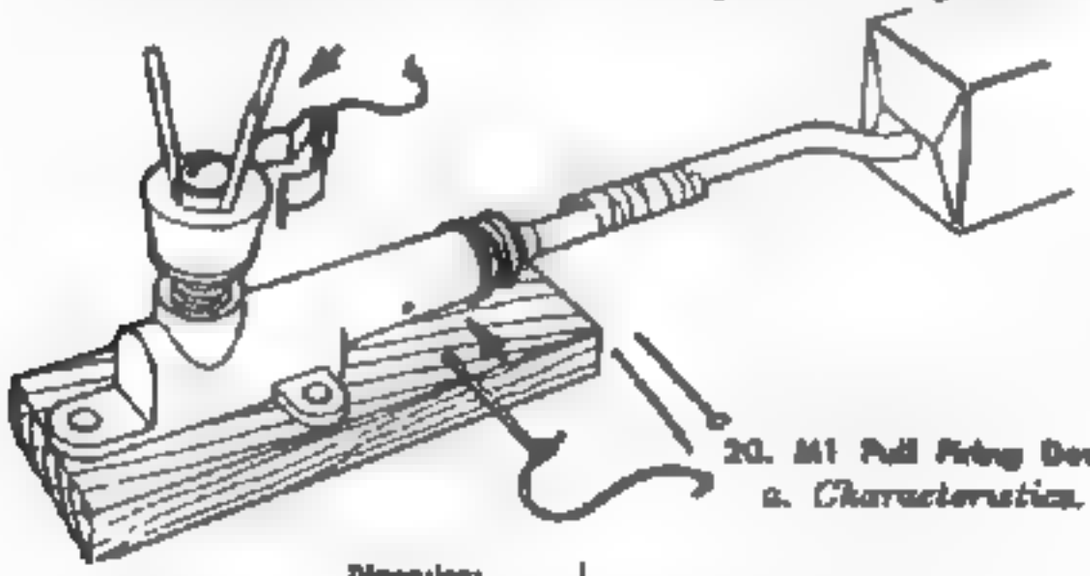
e. Disarming.
(1) Insert length of wire, nail, or original pin in positive safety pin hole.
(2) Replace safety clip, if available.
(3) Separate firing device and explosive block.
(4) Unscrew standard base assembly from firing device.



20. M1 Pull Firing Device
a. Characteristics.

Dimensions					
Case	Color	D	L	Internal Action	Initiating Action
Metal	OD	9/16 in	3 5/16 in	Mechanical with split-head striker release	3 to 5 lb pull on trip wire

Safeties	Packaging
Locking and positive safety pin	Five units complete with standard base and two 50-ft spools of trip wire, are packed in shipboard container. Thirty shipboard containers are packed in wooden box.

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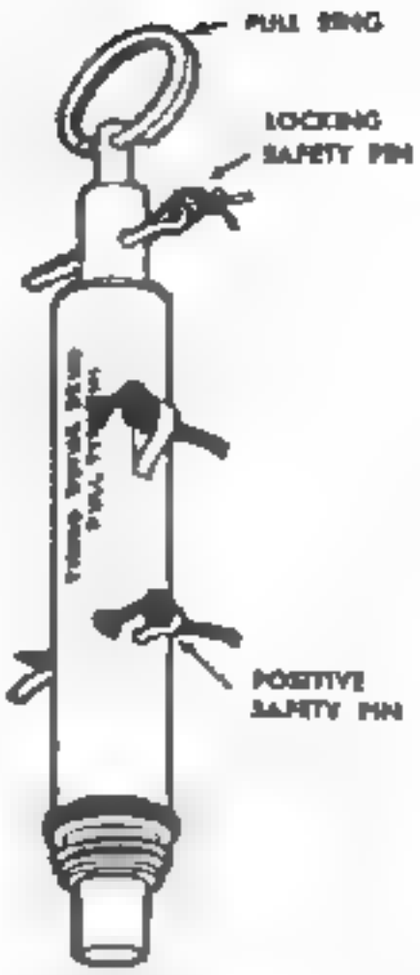
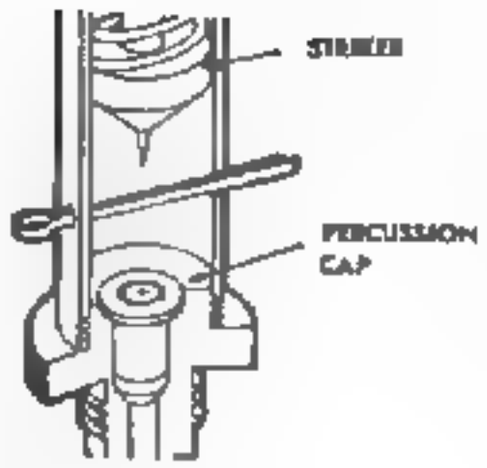
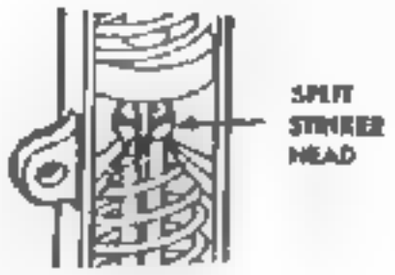
b. Functioning.

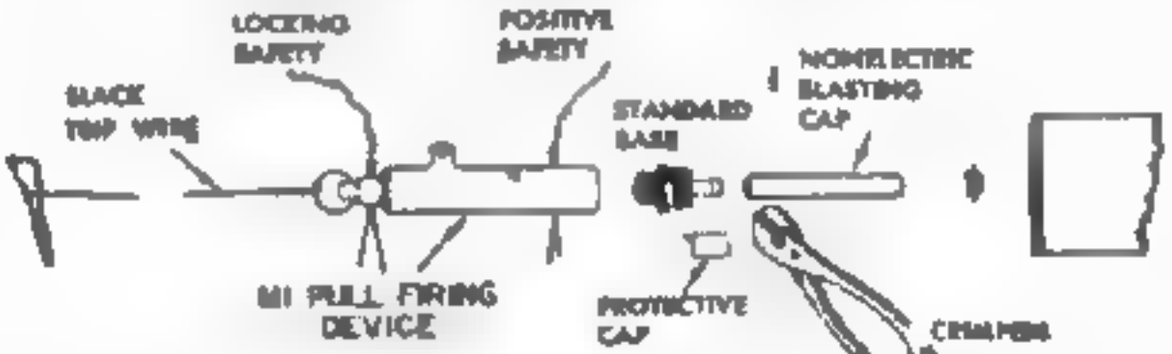
A pull of 3 to 5 lb. on trip wire withdraws tapered end of release pin from split head of striker. This frees striker to fire the percussion cap.







c. Installing.
(1) Remove protective cap.
(2) With crimpers, attach blasting cap to standard base. *Crimper jaws should be placed no farther than ¼ in. from open end of blasting cap.*
(3) Attach firing device assembly to charge.



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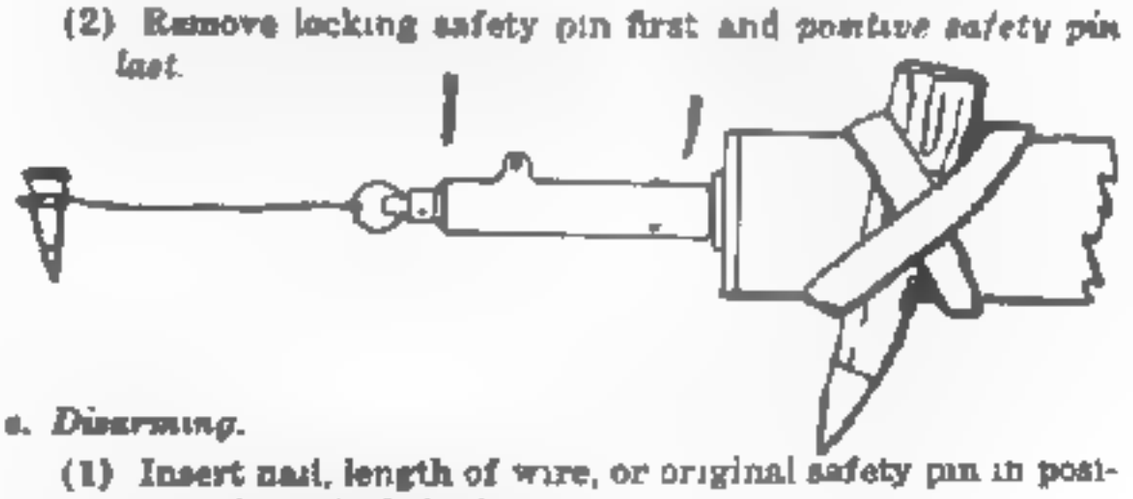
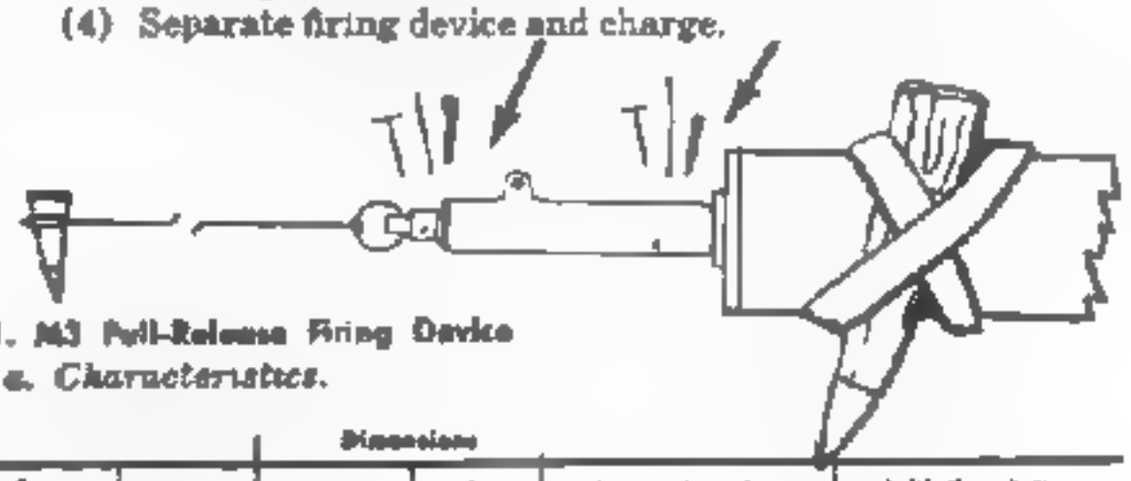
d. Arming.
(1) Anchor trip wire and fasten other end to pull ring.
(2) Remove locking safety pin first and *positive safety pin last.*



e. Disarming.
(1) Insert nail, length of wire, or original safety pin in positive safety pin hole *first*
(2) Insert a similar pin in locking safety pin hole.
(3) Cut trip wire.
(4) Separate firing device and charge.



1. M3 Pull-Release Firing Device
a. Characteristics.

Dimensions					
Case	Color	D	L	Internal Action	Initiating Action
Metal	OD	9/16 in	4 in	Mechanical with spreading striker head release	Direct pull of 5 to 10 lb or release of tension

	Solution	Packaging
23	Locking and positive safety pins	Five units with two 50-ft spools of trip wire in carton, and 5 cartons packed in wooden box

24

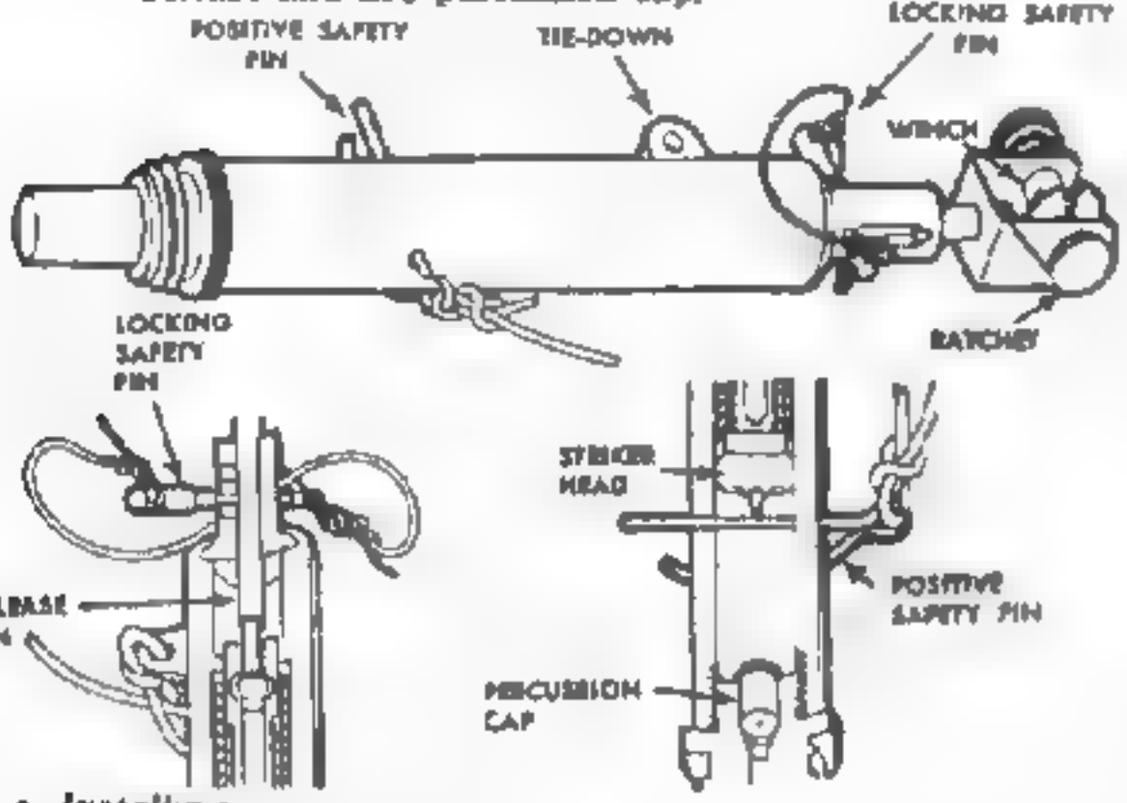
b. Functioning.

(1) Pull.

A pull of 6 to 10 lb. on taut trip wire raises release pin until shoulder passes constriction in barrel. The striker jaws then spring open, releasing striker to fire percussion cap.

(2) Tension-release.

Release of tension (cutting of taut trip wire) permits spring-driven striker to move forward, separate from release and fire percussion cap.



25

c. Installing.

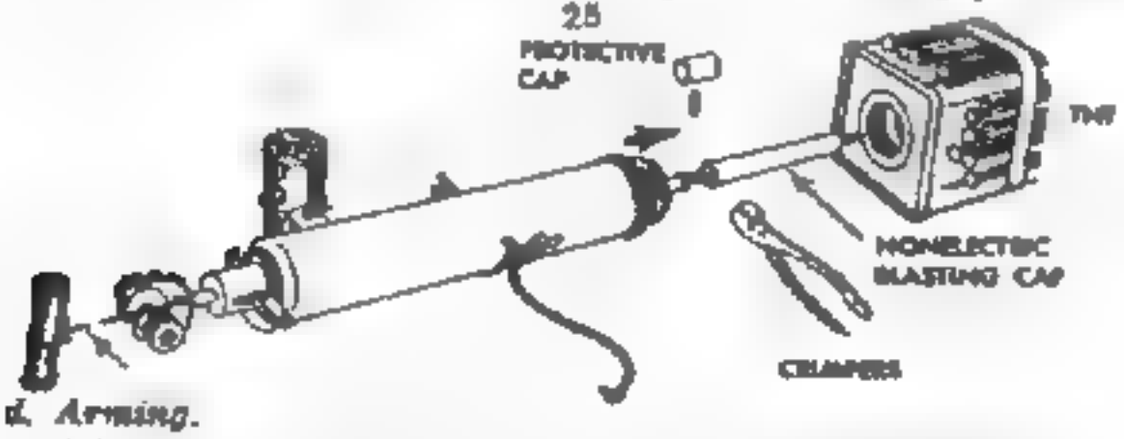
(1) Remove protective cap.

(2) With crimpers, attach blasting cap to standard base. *Crimper jaws should be placed no farther than ¼ in. from open end of blasting cap.*

(3) Attach firing device assembly to anchored charge (must be firm enough to withstand pull of at least 20 lb.).

(4) Secure one end of trip wire to anchor and place other end in hole in winch.

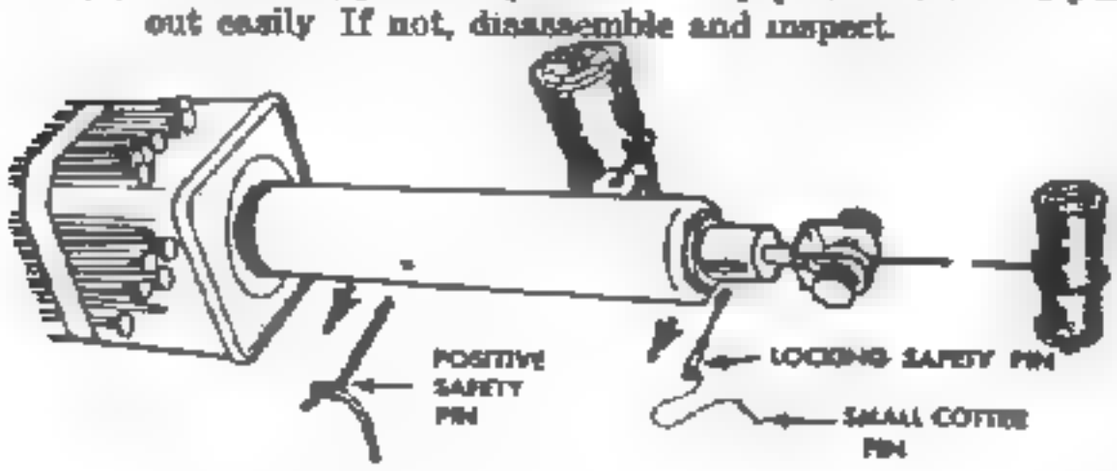
(5) With knurled knob draw up trip wire until locking safety pin is pulled into wide portion of safety pin hole.



d. Arming.

(1) With cord, remove small cotter pin from locking safety pin and withdraw locking safety pin. If it does not pull out easily, adjust winch winding.

(2) With cord, pull out positive safety pin. This should pull out easily. If not, disassemble and inspect.



e. Disarming.

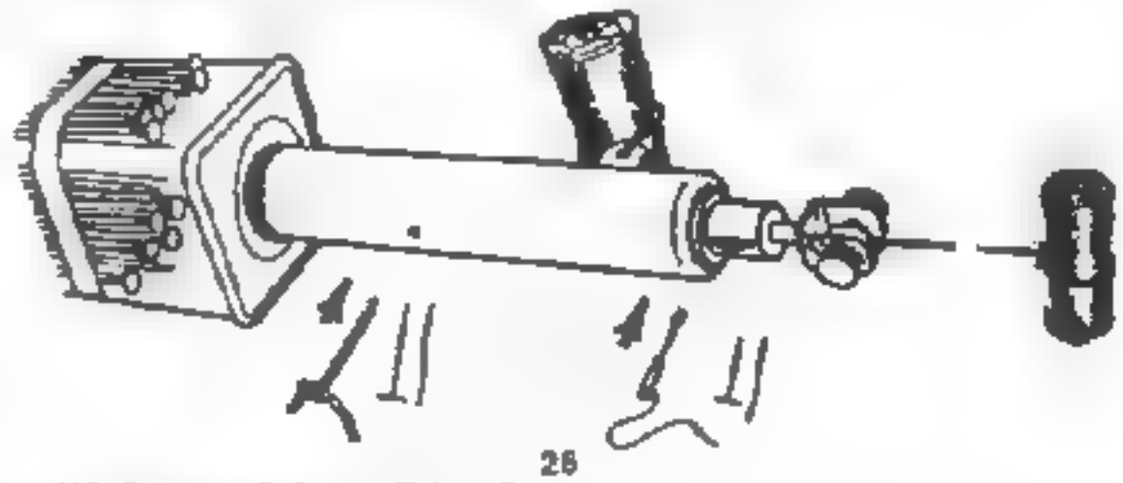
(1) Insert length of wire, nail, or cotter pin in positive safety pin hole.

(2) Insert length of wire, nail, of safety pin in locking safety pin hole.

(3) Check both ends and cut trip wire.

(4) Separate firing device from charge.

Note. Insert positive safety pin first. Cut trip wire last.



26

22. M5 Pressure-Release Firing Device

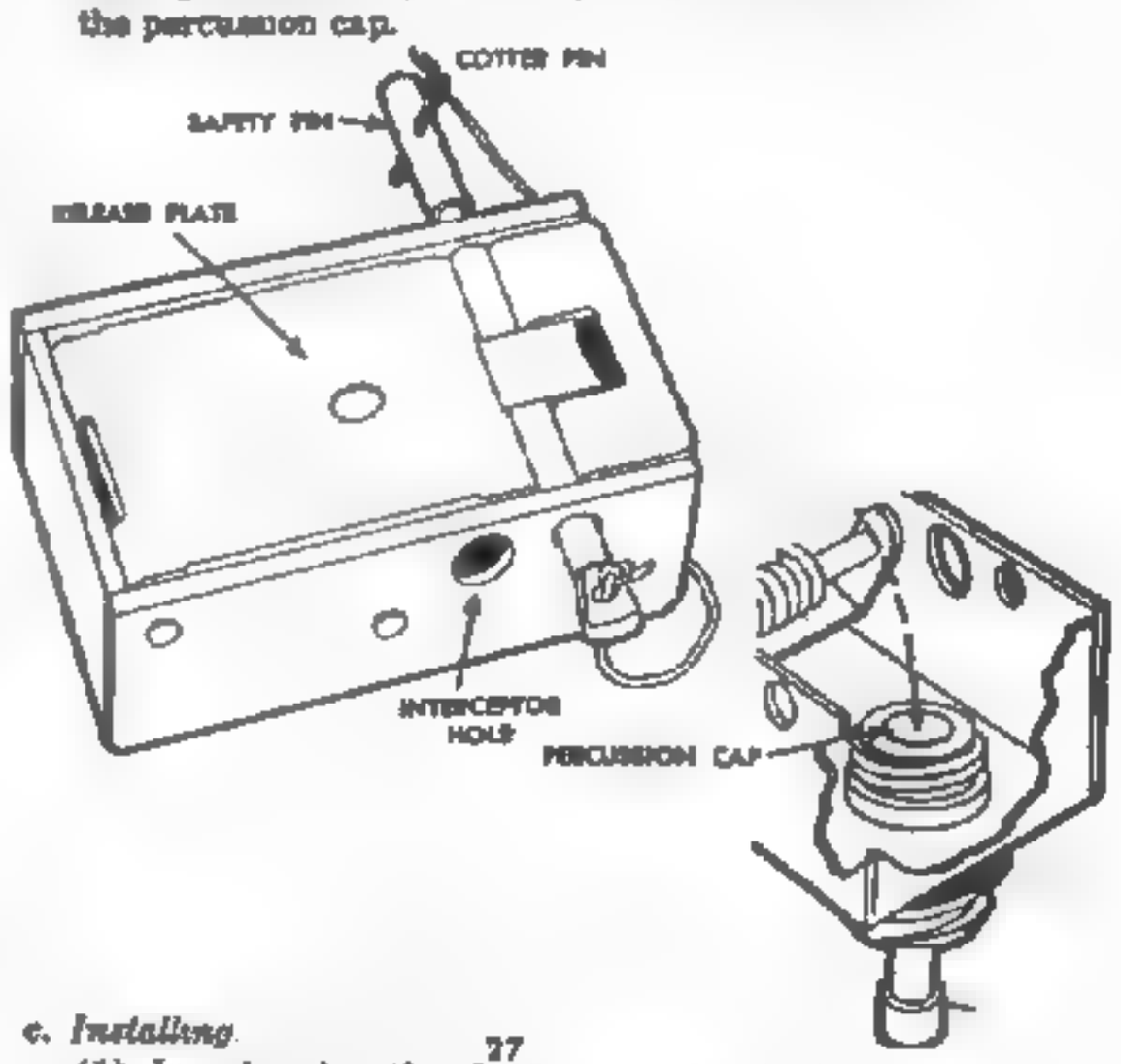
a. Characteristics.

Case	Color	Dimensions L	W	HT	Internal Action	Initiating Action
Metal	OD	1¾	15/16	11/16	Mechanical with hinged plate release	removal of restraining wt, 5 lb or more

Accessories	Solution	Packaging
Pressure hazard	Safety pin and hole for intercept pin	Four firing devices complete and four plywood pressure boards in paper carton. Five cartons are packaged in fiber board box and 10 of these shipped in wooden box.

b. Functioning.

Lifting or removing retaining weight releases striker to fire the percussion cap.



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c. Installing.

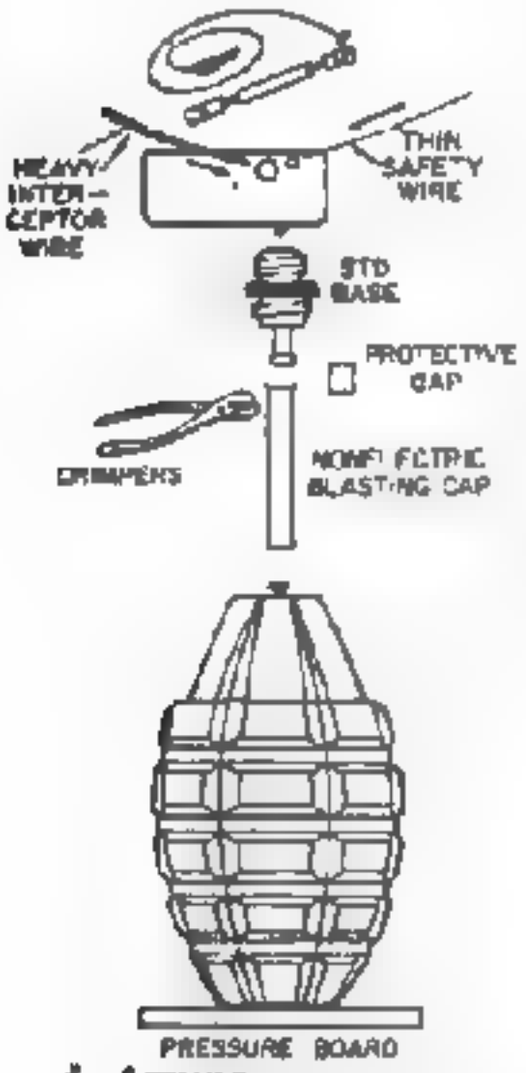
(1) Insert a length of 10-gage wire in interceptor hole. Bend slightly to prevent dropping out.

(2) Remove small cotter pin from safety pin.

(3) Holding release plate down, replace safety pin with length of No. 18 wire. Bend wire slightly to prevent dropping out.

(4) Remove protective cap from base and with crimpers, attach blasting cap. *Crimper jaws should be placed no farther than ¼ inch from open end of blasting cap.*

(5) Secure firing device assembly in charge.



d. Arming.

(1) Place restraining weight on top of firing device.

(2) Remove thin wire from safety pin hole. If wire does not come out easily, restraining weight is either insufficient or improperly placed.

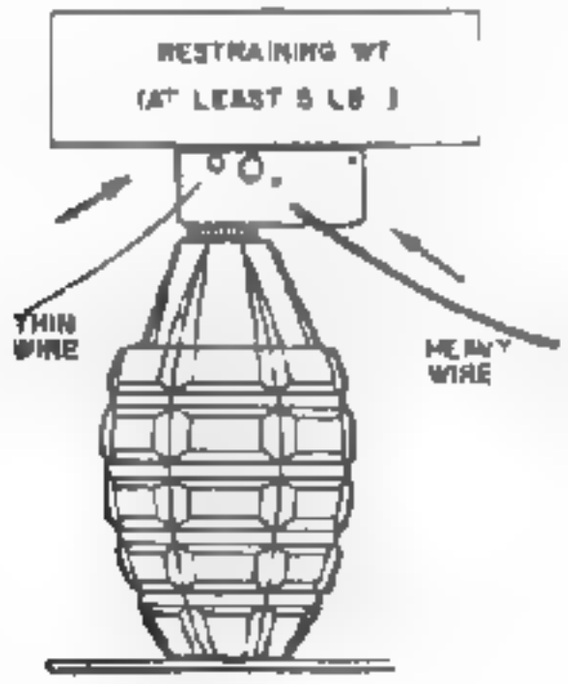
(3) Remove heavy wire from interceptor hole. It should move freely. *Note. Withdraw thin wire first and heavy wire last. Follow arming procedure carefully*

28

e. Disarming.

(1) Insert length of heavy gage wire in interceptor hole. Bend wire to prevent dropping out. *Proceed carefully, as the slightest disturbance of the restraining weight might initiate the firing device.*

(2) Separate firing device from charge.



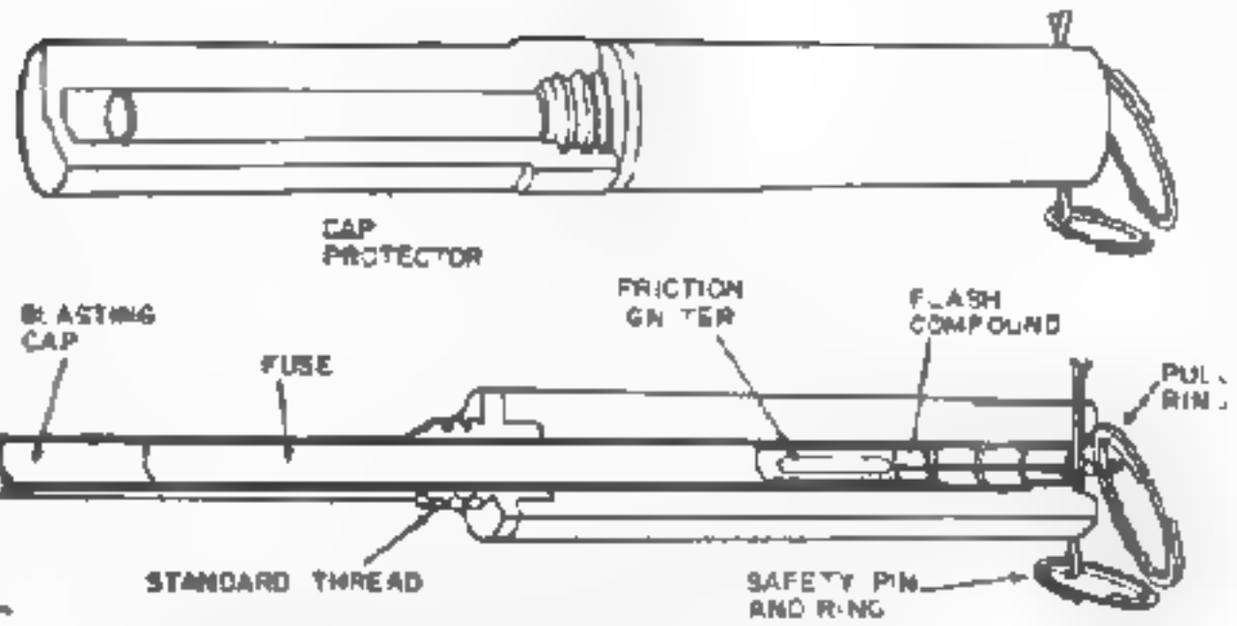
23. 15-Second Delay Detonator

a. Characteristics.

This device consists of a pull-friction fuse igniter, 15-second length of fuse, and blasting cap. The blasting cap is protected by a transit cap screwed on the base.

b. Functioning.

A strong pull on the pull ring draws the friction igniter through the flash compound, causing a flame which ignites the time fuse.



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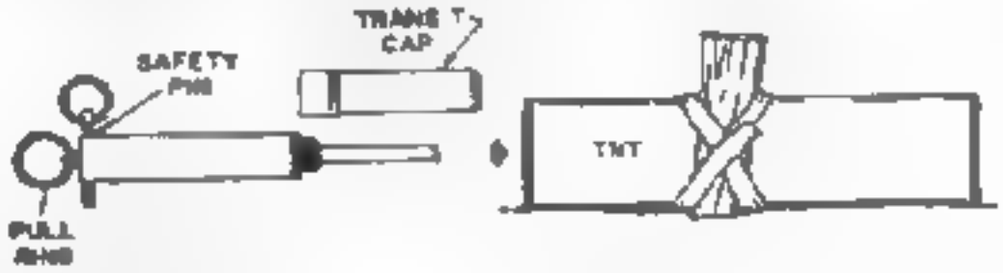
c. Installing.

(1) Unscrew transit cap from base.

(2) Secure device in charge.



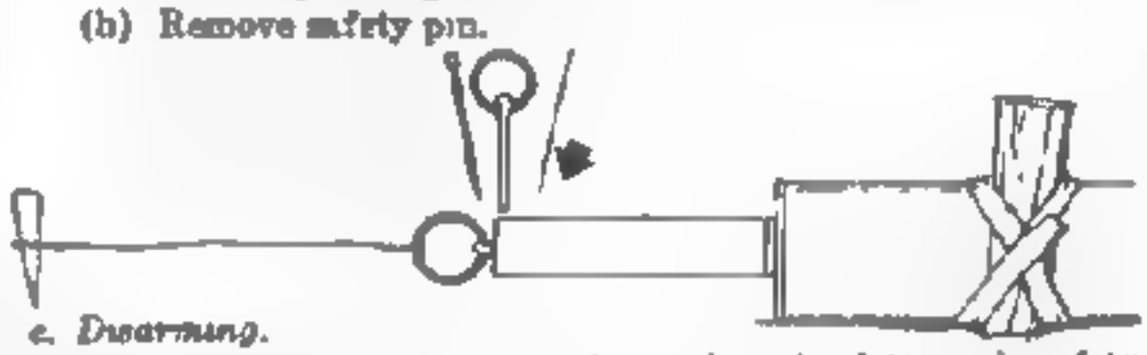
d. Arming.

(1) *Manual initiation.* Remove safety pin.

(2) *Trip wire initiation.*

(a) Attach one end of trip wire to anchor stake and the other to pull ring.

(b) Remove safety pin.

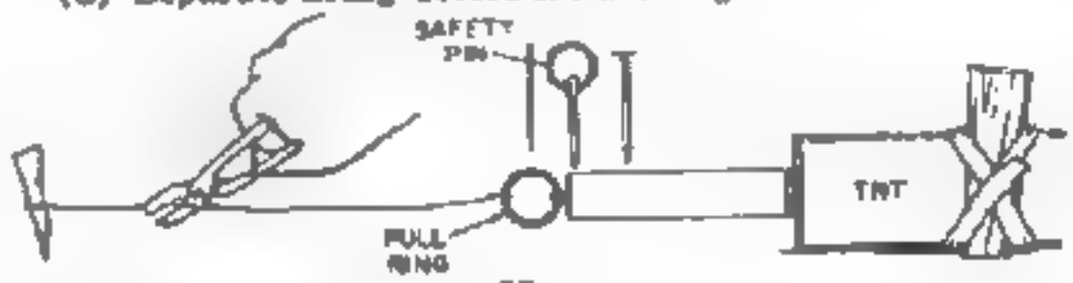


e. Disarming.

(1) Insert length of wire, nail, or original safety pin in safety pin hole.

(2) Remove trip wire.

(3) Separate firing device from charge.



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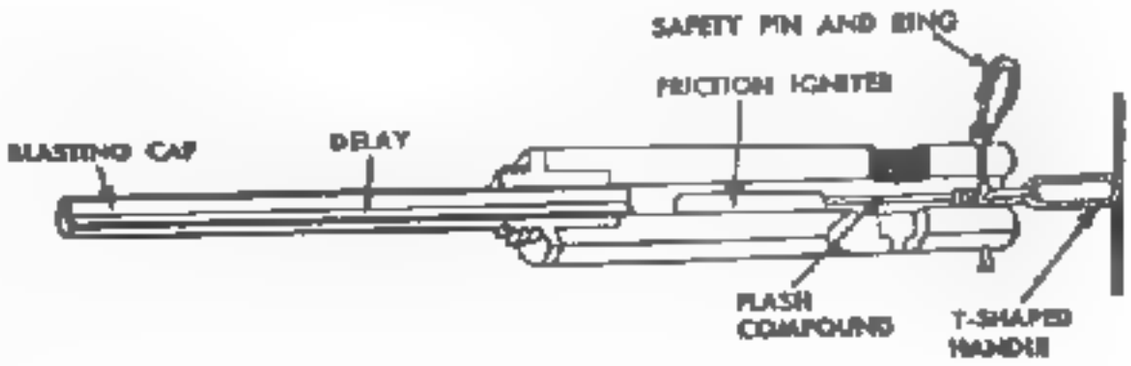
24. 8-Second Delay Detonator

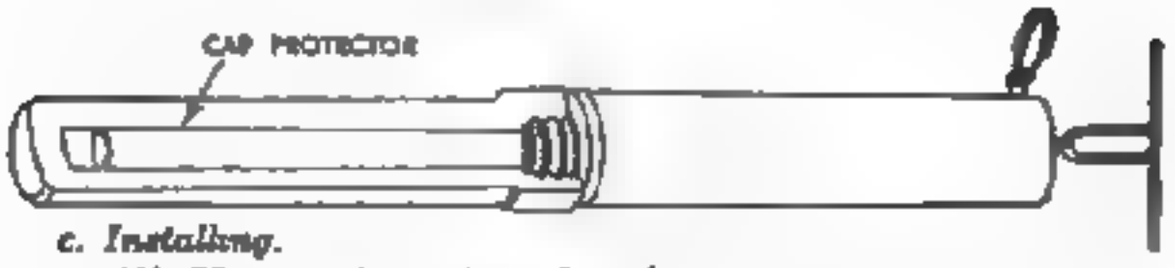
a. Characteristics.

This device consists of a pull-type fuse lighter, 8-second length of fuse, and a blasting cap. The blasting cap is protected by a transit cap, screwed on the base.

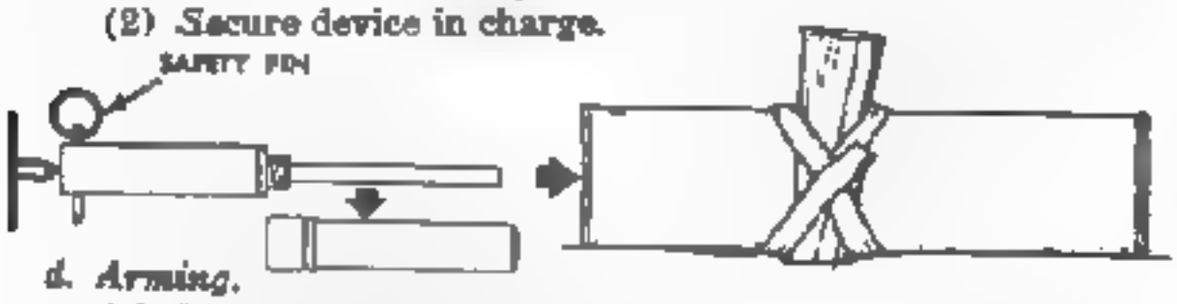
b. Functioning.

A strong pull on the T-shaped handle draws the friction igniter through the flash compound, causing a flame that ignites the time fuse.

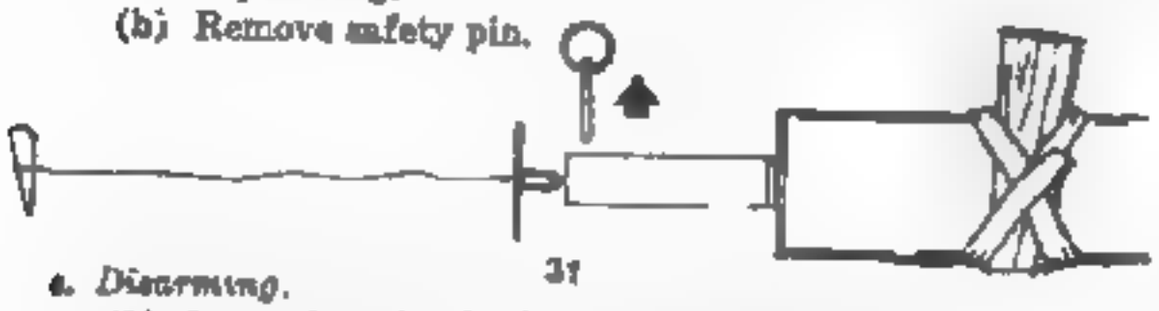




c. Installing.
(1) Unscrew transit cap from base.
(2) Secure device in charge.



d. Arming.
(1) Manual initiation: Remove safety pin.
(2) Trip wire initiation.
(a) Attach one end of trip wire to anchor stake and the other to pull ring.
(b) Remove safety pin.



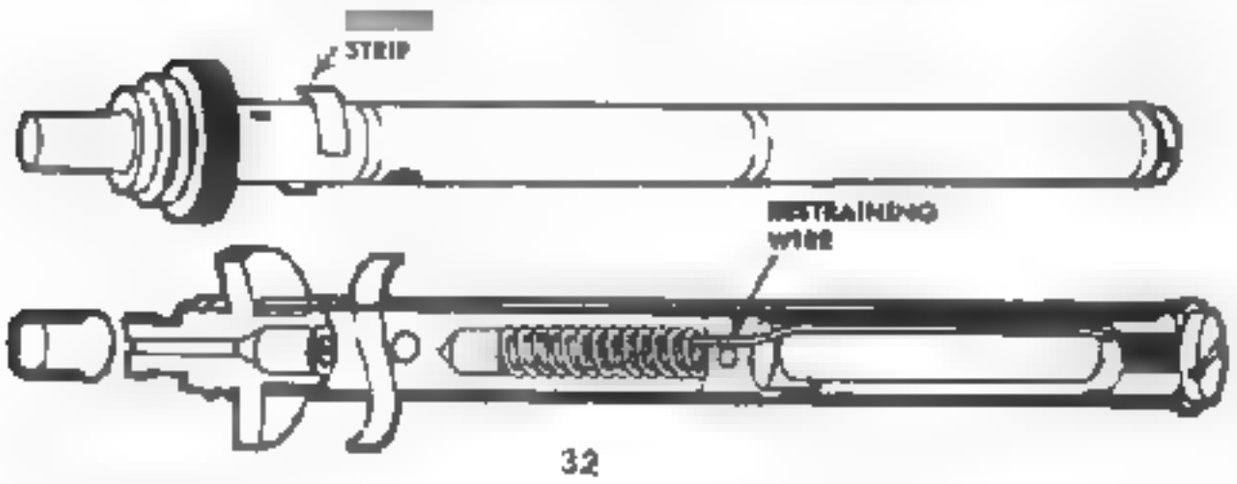
e. Disarming.
(1) Insert length of wire, nail, or safety pin in safety pin hole.
(2) Remove trip wire.
(3) Separate firing device from charge.

25. M3 Delay Firing Device
a. Characteristics.

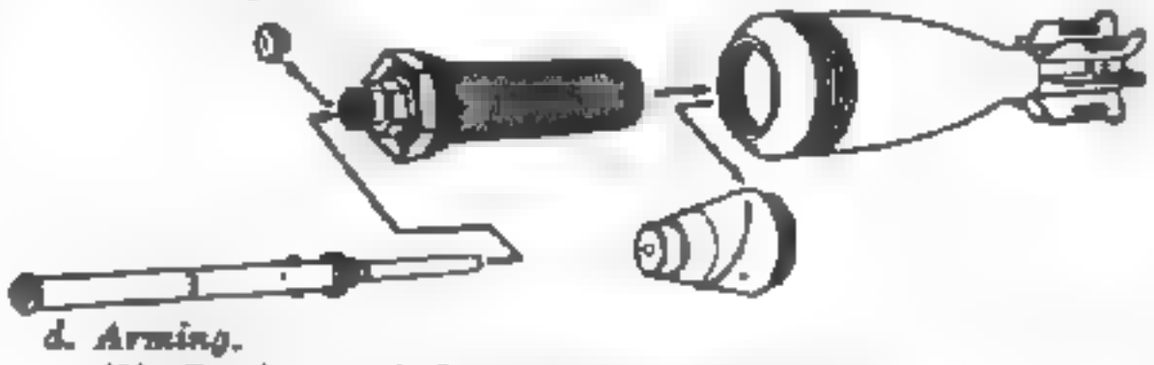
Dimensions					
Case	Color	D	L	Internal Action	Delay
Copper and brass	Natural Metal	7/16 in	6½ in	Mechanical with corrosive chemical release	4 min to 9 days, identified by color of safety strip

Safety	Packaging
Colored strip inserted in hole above percussion cap.	10 units—2 red, 2 white, 2 green, 1 yellow, and 1 blue—and a time delay temperature chart packed in paper board carton, 10 cartons in fiber board box, and 3 boxes in wooden box.

b. Functioning
Squeezing copper half of case crushes ampule, releasing chemical to corrode restraining wire and release striker.



c. Installing.
(1) Select device of proper delay.
(2) Insert nail in inspection hole to make sure that firing pin has not been released.
(3) Remove protective cap from base.
(4) With crimpers, attach blasting cap to base. *Crimper jaws should be placed no farther than ¼ in. from open end of blasting cap.*
(5) Secure firing device assembly in destructor and then in charge.



d. Arming.
(1) Crush ampule by squeezing the copper portion of case.
(2) Remove safety strip.

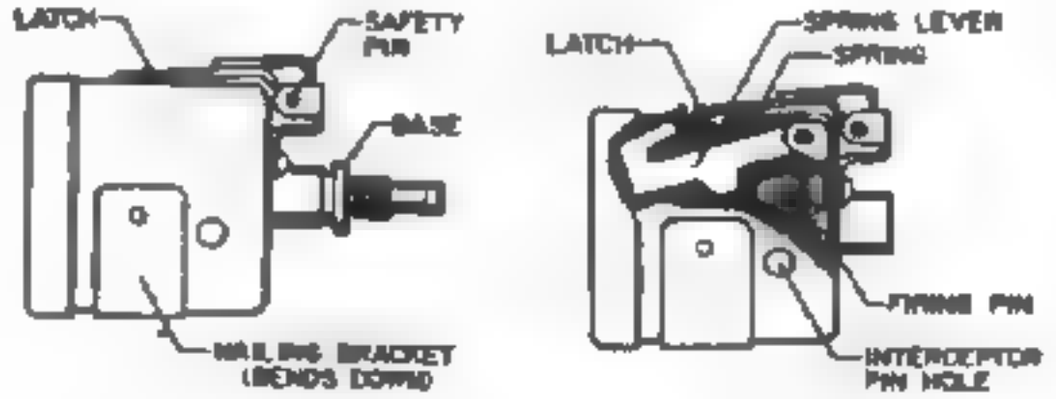
e. Disarming.
There is no safe way of disarming this firing device. If disarming is necessary, insert an improvised safety pin through inspection holes.

26. M1 Pressure-Release Firing Device
a. Characteristics.

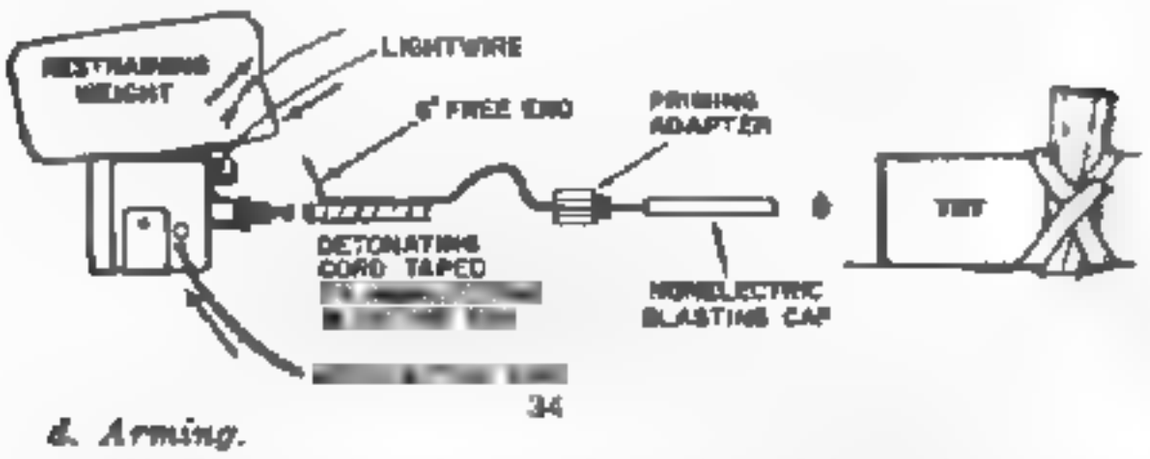
Dimensions						
Case	Color	L	W	H	Internal Action	Restraining Pressure
Metal	OD	3 in	2 in	2 in	Mechanical with springed latch release	3 lb or more

Safeties	Issue
Safety pin and hole for interceptor pin	Obsolete, but many are still available

b. Functioning.
Lifting or removing restraining weight unlatches lever, releasing striker to fire percussion cap.



c. Installing.
(1) Insert a length of heavy gage wire in interceptor hole. Bend slightly to prevent dropping out.
(2) Holding down latch, remove safety pin and replace with length of thin wire.
(3) Remove protective cap from base and with crimpers attach nonelectric blasting cap. *Crimper jaws should be placed no farther than ¼ in. from open end of blasting cap.*
(4) Assemble length of detonating cord, priming adapter, nonelectric blasting cap, and explosive block.
(5) Attach free end of detonating cord to blasting cap on M1 release device with friction tape, allowing 6 in. of detonating cord to extend beyond joint.



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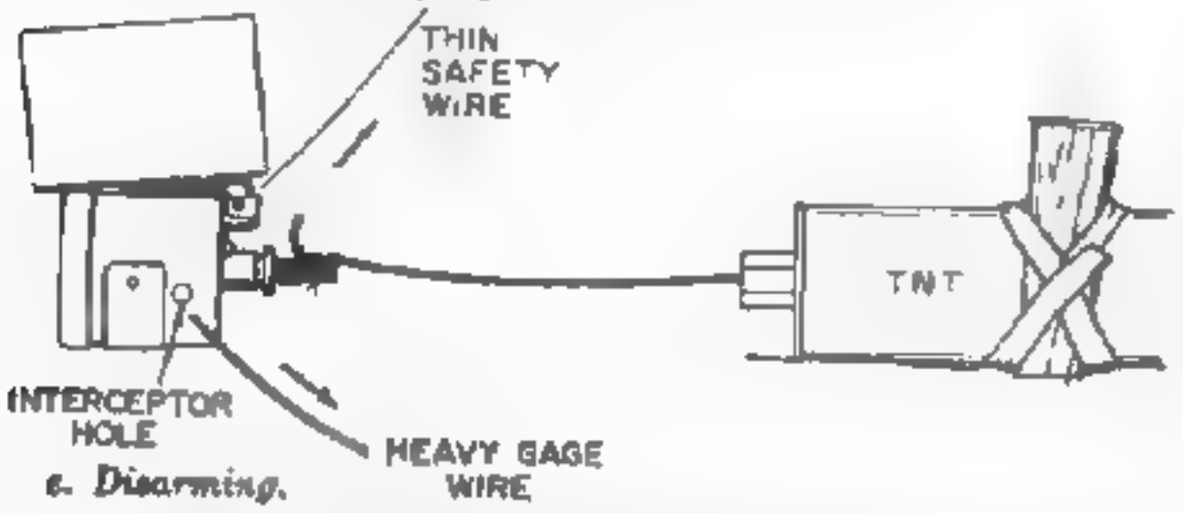
d. Arming.

(1) Place restraining weight on top of firing device.

(2) Remove thin wire from safety pin hole. If it does not come out easily, restraining weight is either insufficient or improperly placed.

(3) Remove heavy wire from interceptor hole.

Note. Proceed carefully.

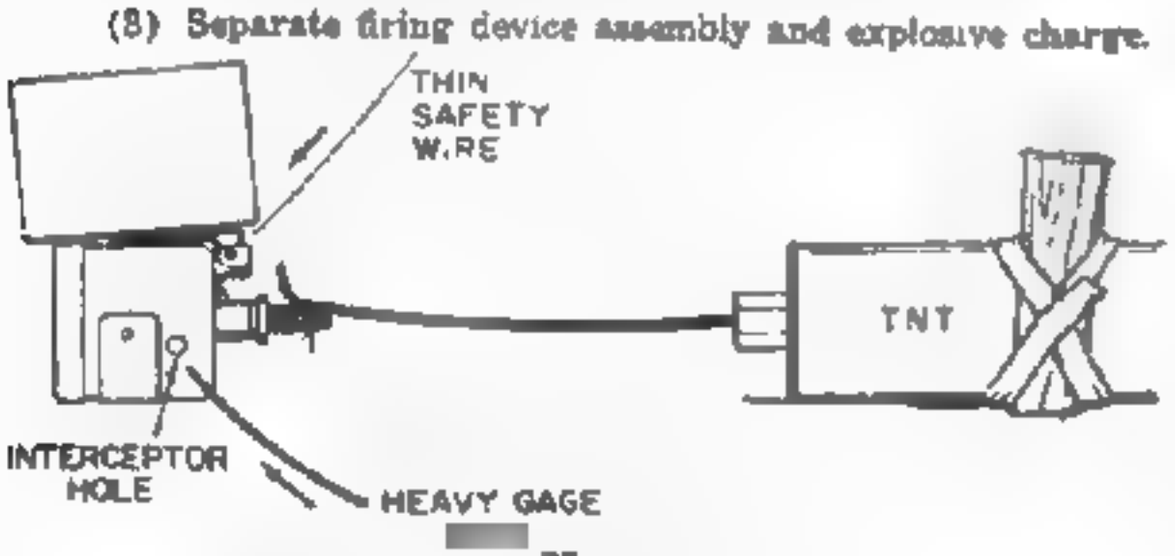


e. Disarming.

(1) *Proceed carefully as the slightest disturbance of restraining weight might unlatch lever and detonate the mine.* Insert length of heavy gage wire in interceptor hole. Bend wire to prevent dropping out.

(2) Insert length of thin wire in safety pin hole, if possible.

(3) Separate firing device assembly and explosive charge.



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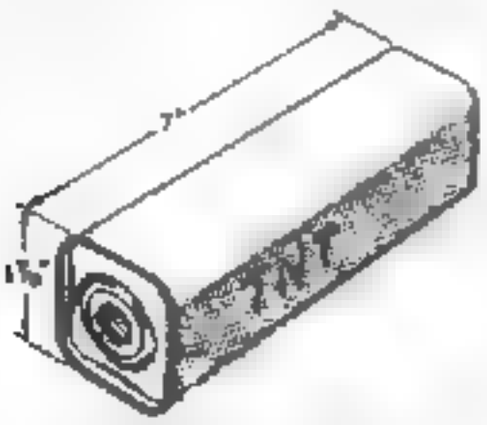
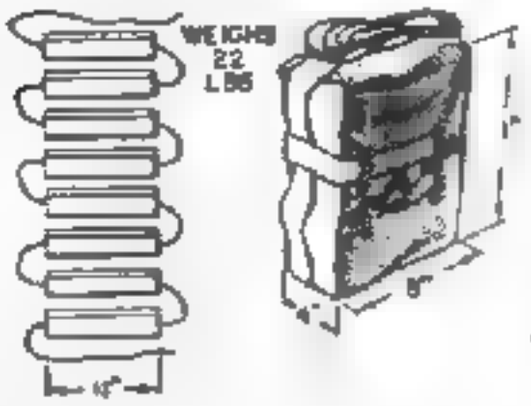
Section II. DEMOLITION MATERIALS

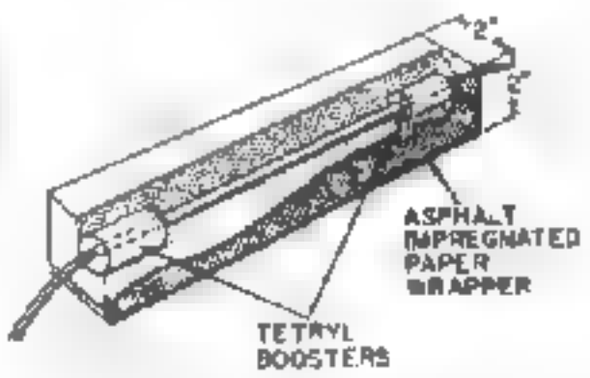
27. Explosives and Accessories (For more detailed information, see FM5-25 and TM 9-1375-200.)

a. TNT. This is issued in ¼, ½ and 1-pound blocks in a cardboard container with lacquered metal ends. One end has a threaded cap well. Half-pound blocks are obtained by cutting a 1-pound package in the center.

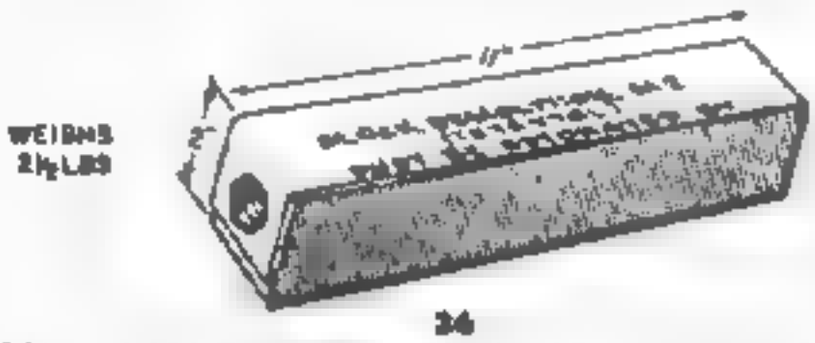


b. M1 Chain Demolition Blocks (Tetrytol). This explosive consists of eight 2½-pound tetrytol blocks cast 8 inches apart onto a single line of detonating cord, which extends 2 feet beyond the end blocks. All blocks have a tetryl booster in each end. Each chain is packed in a haversack, and two haversacks in a wooden box.





c. M2 Demolition Block (Tetrytol). The M2 demolition block is enclosed in an asphalt impregnated paper wrapper. It has a threaded cap well in each end. Eight blocks are packed in a haversack, and two haversacks in a wooden box.



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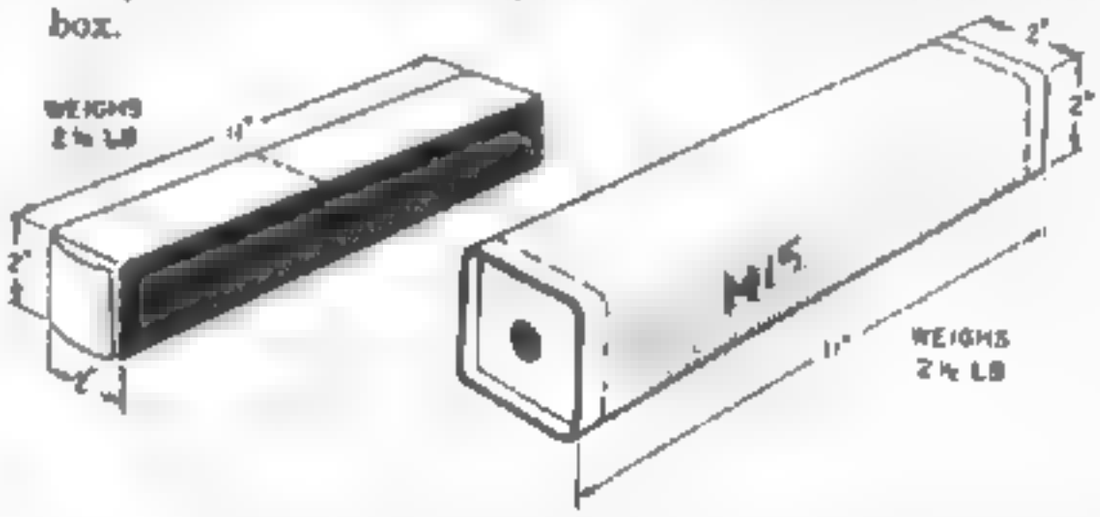
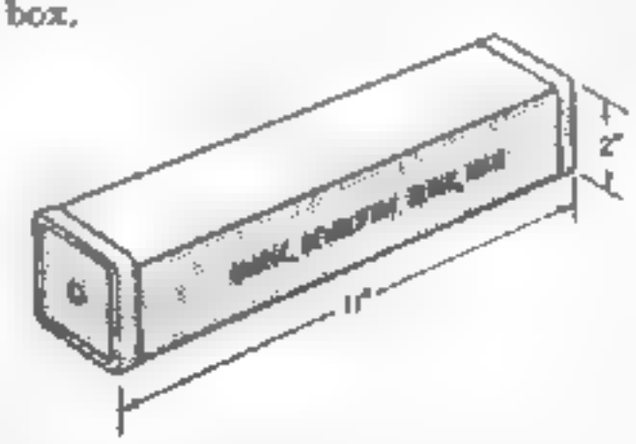
d. M3 and M5 Demolition Blocks (Composition C3). These consist of a yellow, odorous, plastic explosive more powerful than TNT. The M3 block has a cardboard wrapper perforated around the middle for easy opening. The M5 block has a plastic container with a threaded cap well. Eight M3 or M5 blocks are packed in a haversack; and two haversacks in a wooden box.



e. M5A1 Demolition Block (Composition C4). This is a white plastic explosive more powerful than TNT, but without the odor of C3. Each block is wrapped in plastic covering with a threaded cap well in each end. Twenty-four blocks are packed in a wooden box.



f. M112 Demolition Charge (Composition C4). This is composition C4 in a new package measuring 1 in. x 2 in. x 12 in. Each block has an adhesive compound on one face. Further information is not available.

g. M118 Demolition Charge. The M118 charge is composed of PETN and plasticizers. The detonating rate is approximately 23,000 ft. per second. Each package contains four sheets ¼ in. x 3 in. x 12 in. Each sheet has an adhesive compound on one face. Further information is unavailable.

h. Composition B. Composition B is a high explosive with a relative effectiveness higher than TNT, and more sensitive.

Because of its high dentonation rate and shattering power, it is used in certain bangalore torpedoes and in shaped charges.

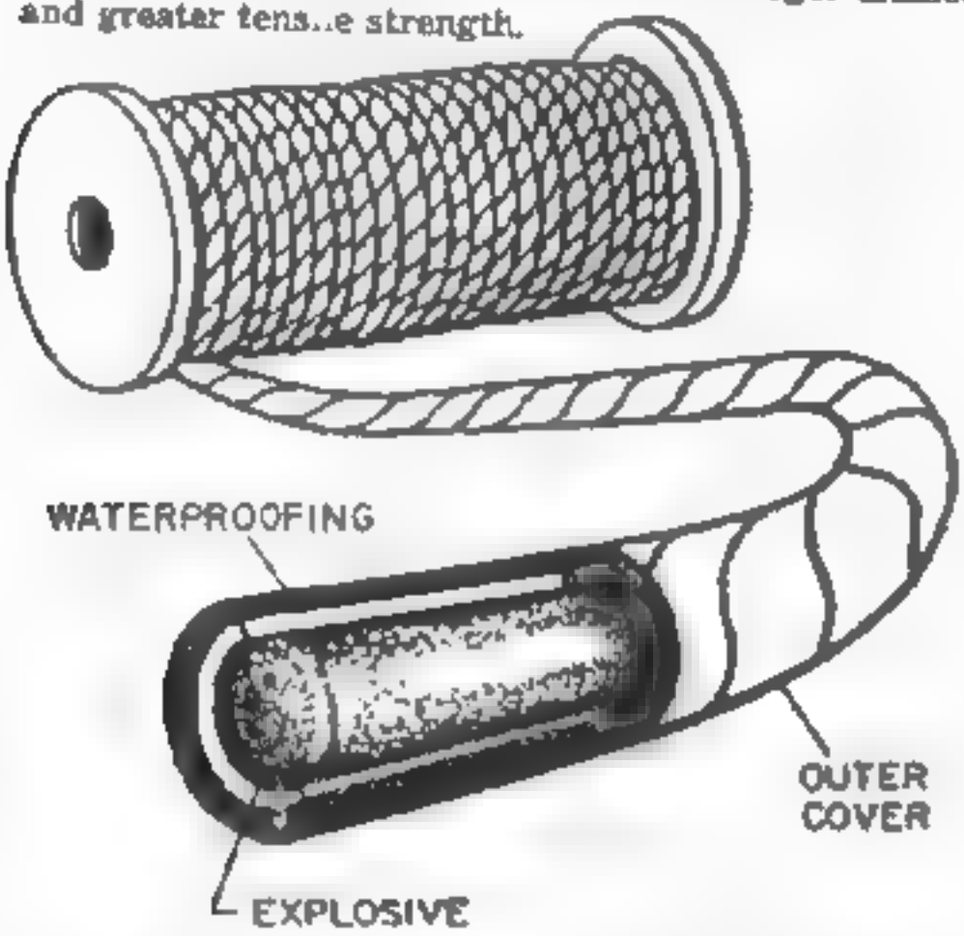
i. *PETN.* This is used in detonating cord. It is one of the most powerful military explosives, almost equal to nitroglycerine and RDX. In detonating cord, PETN has a velocity rate of 21,000 feet per second.

j. *Amatol.* Amatol, a mixture of ammonium nitrate and TNT, has a relative effectiveness higher than that of TNT. Amatol (80/20) is used in the bangalore torpedo.

k. *RDX.* This is the base charge in the M6 and M7 electric and nonelectric blasting caps. It is highly sensitive, and has a shattering effect second only to nitroglycerine.

l. *Detonating Cord.*

(1) *Types I and II.* These consist of a flexible braided seamless cotton tube filled with PETN. On the outside is a layer of asphalt covered by a layer of rayon with a wax gum composition finish. Type II has the larger diameter and greater tensile strength.



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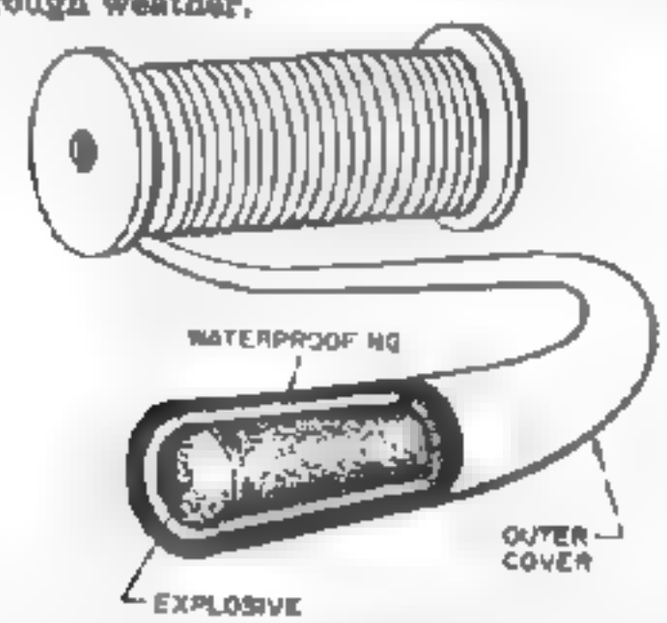
(2) *Type IV.* This is similar to types I and II, except for the special smooth plastic covering designed for vigorous use and rough weather.



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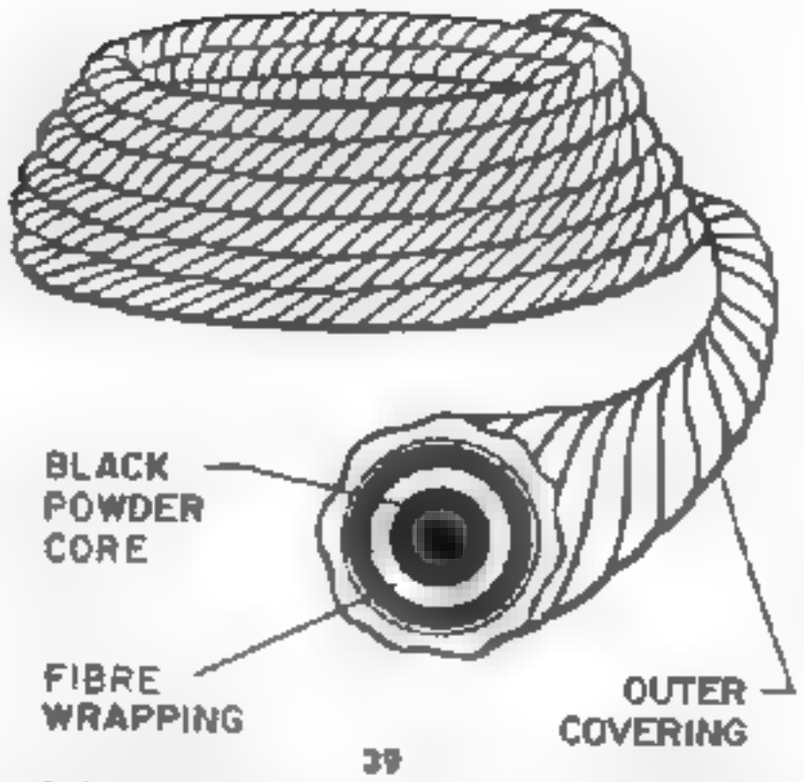
m. *Blasting Time Fuse.* This consists of black powder tightly wrapped in layers of fabric and waterproofing materials. It may be any color, orange being the most common. As burning rate varies from about 30 to 45 seconds per foot, each roll must be tested before using by burning and timing a 1-foot length.

n. *Safety Fuse M700.* This fuse is a dark green cord with a plastic cover, either smooth or with single pointed abrasive bands around the outside at 1-foot or 18-inch intervals and double



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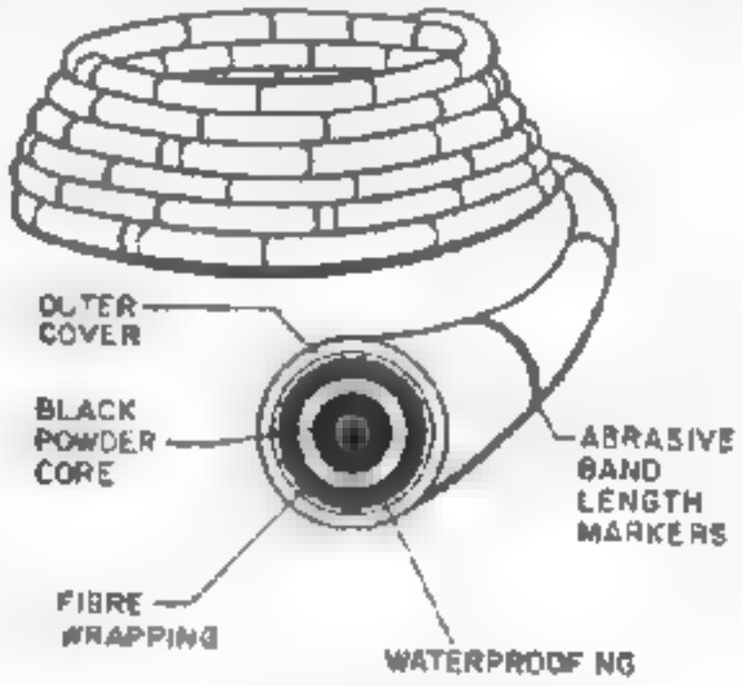
painted abrasive bands at 5-foot or 90-inch intervals. Although the burning rate is uniform (about 40 seconds per foot), it should be tested before using by burning and timing a 1 foot length.



o. *M60 Fuse Lighter.*

(1) *To install: Unscrew the fuse holder cap, remove shipping* plug, insert time fuse, and tighten cap.

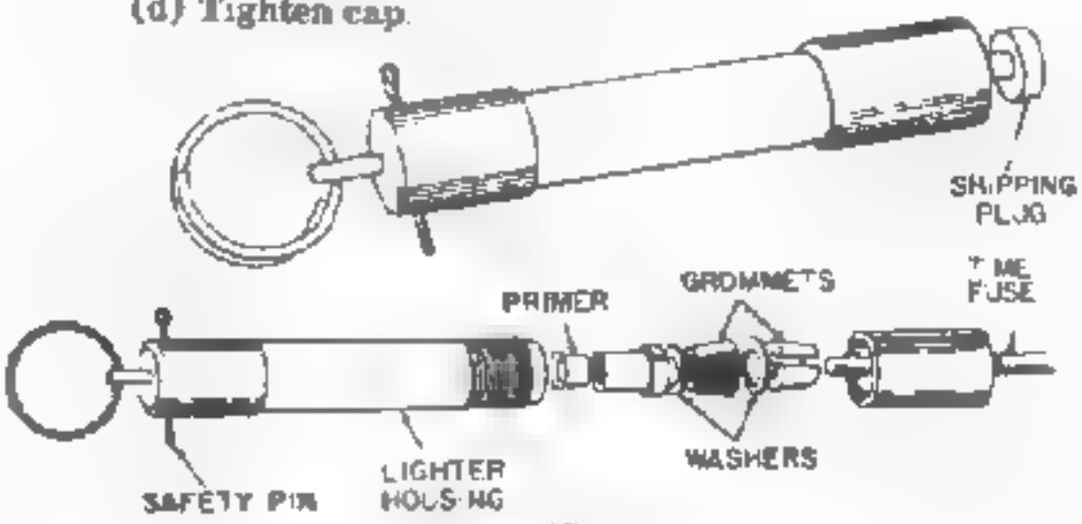
(2) *To reload.*

(a) Insert primer base and primer in end of lighter housing.

(b) Put washers and grommets in open end of fuse holder cap as shown, and screw fuse holder cap firmly on housing.

(c) Unscrew fuse holder cap about three turns and insert a freshly cut end of time fuse into the hole in the cap until it rests against the primer.

(d) Tighten cap.



40

(3) *To fire:*

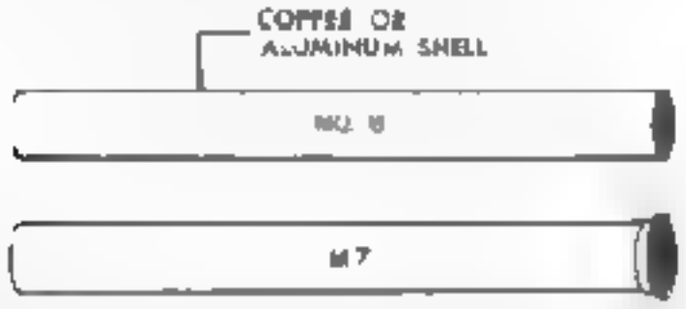
(a) Remove safety pin.

(b) Pull on pull ring.

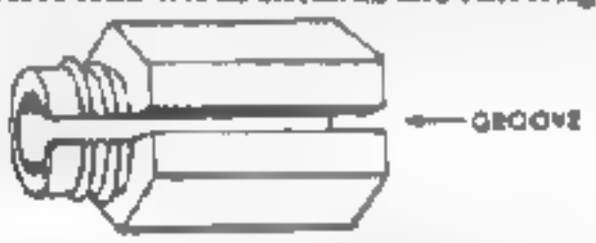
Note. Lighter is reusable after the insertion of a new primer and the reassembly of parts.

p. *Electric Blasting Caps* Electric blasting caps have three lengths of leads—short (4 to 10 ft.), medium (12 to 14 ft), and long (50 to 100 ft). The short-circuit tab or shunt prevents accidental firing It must be removed before the cap is connected in the firing circuit. Military blasting caps are required to insure detonation of military explosives.

q. *Nonelectric Blasting Caps.* Two types are available, the No. 8 and the special M7, which resembles the No. 8 in appearance except for the expanded open end

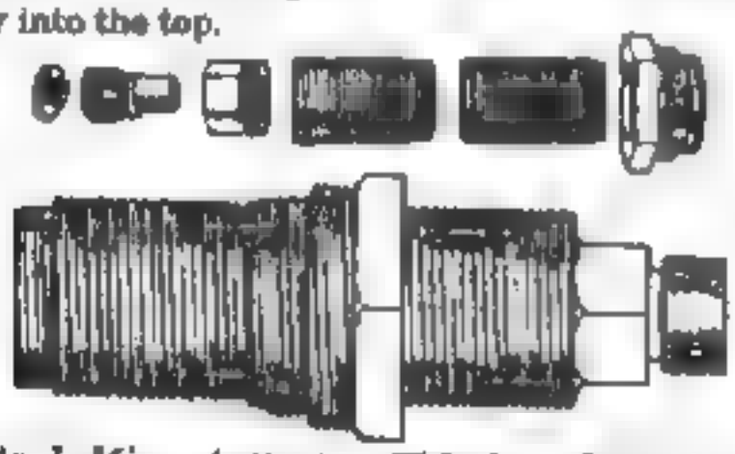


r. *Priming Adapter.* This is a plastic device with a threaded end for securing electric and nonelectric primers in the threaded cap wells of military explosives A groove for easy insertion of the electric lead wires extends the full length of the adapter

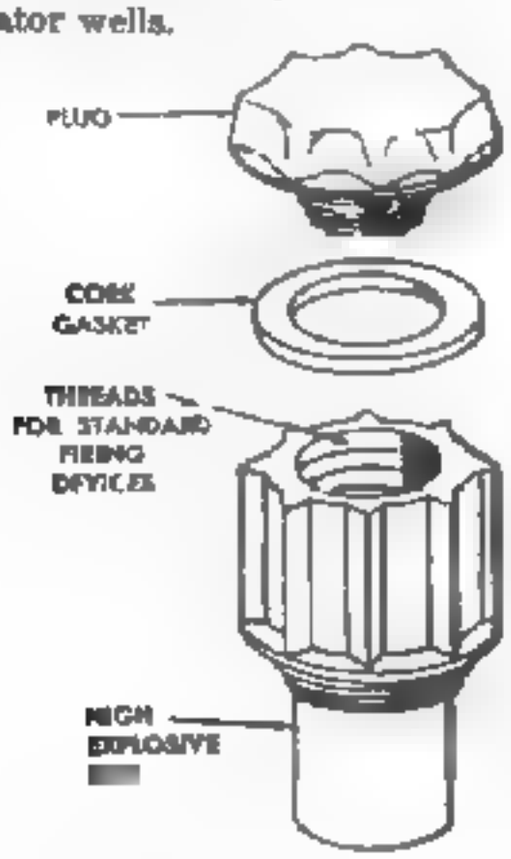


41

s. *M10 Universal Destructor.* The destructor is used to convert loaded projectiles, missiles, and bombs into improvised charges. The destructor has booster caps containing tetryl pellets. All standard firing devices with the standard base coupler screw into the top.



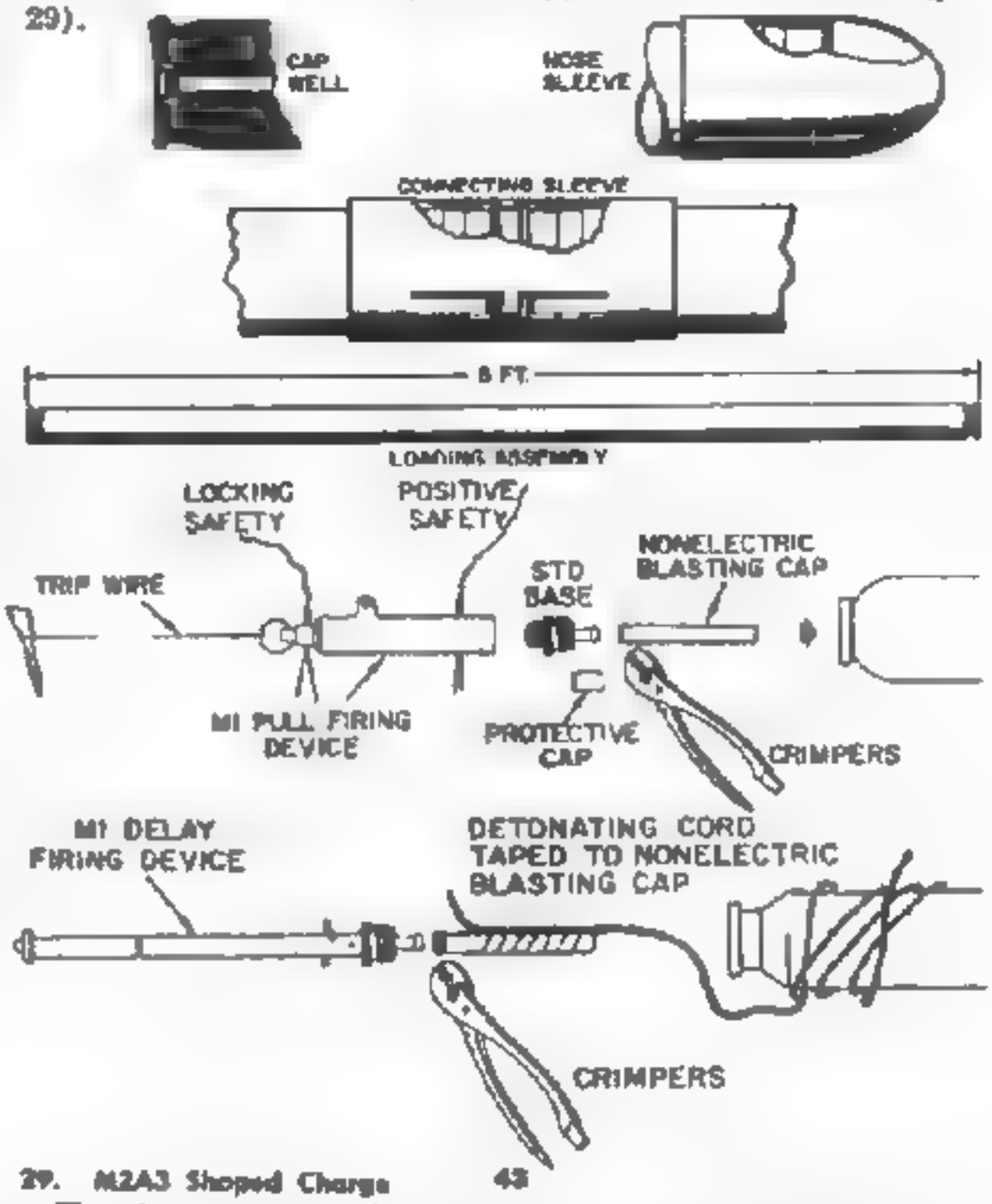
t. *Antitank Mine Activator.* This is a detonator designed for boobytrapping antitank mines. The top is threaded to receive all standard firing devices, and the base to screw in antitank mine activator wells.



42

28. Bangalore Torpedo

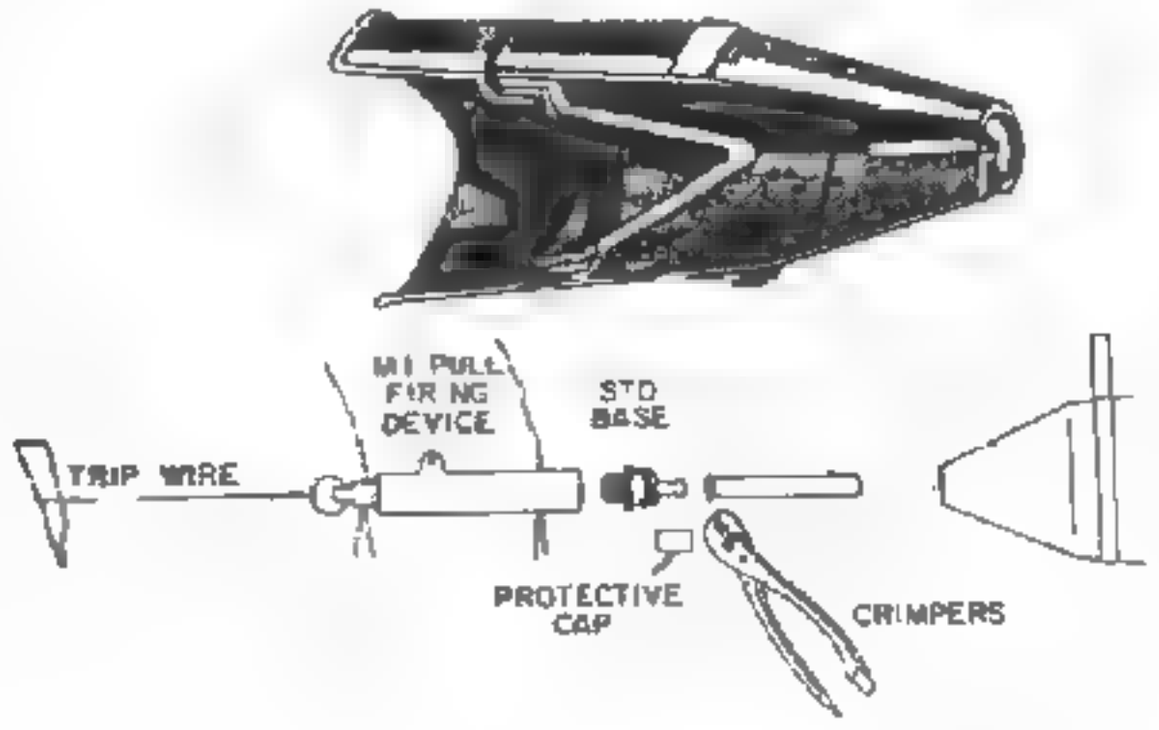
The bangalore torpedo is a group of 10 loading assemblies (steel tubes filled with high explosive) with nose sleeve and connecting sleeves. The loading assemblies may be used singly, in series, or in bundles. They are primed in four ways: by a standard firing device; a standard firing device, nonelectric blasting cap, length of detonating cord, priming adapter, and nonelectric blasting cap (para 29); a standard firing device, and length of detonating cord attached by the clove hitch and two extra turns around the cap well at either end of the loading assembly; and electrical methods (para 29).

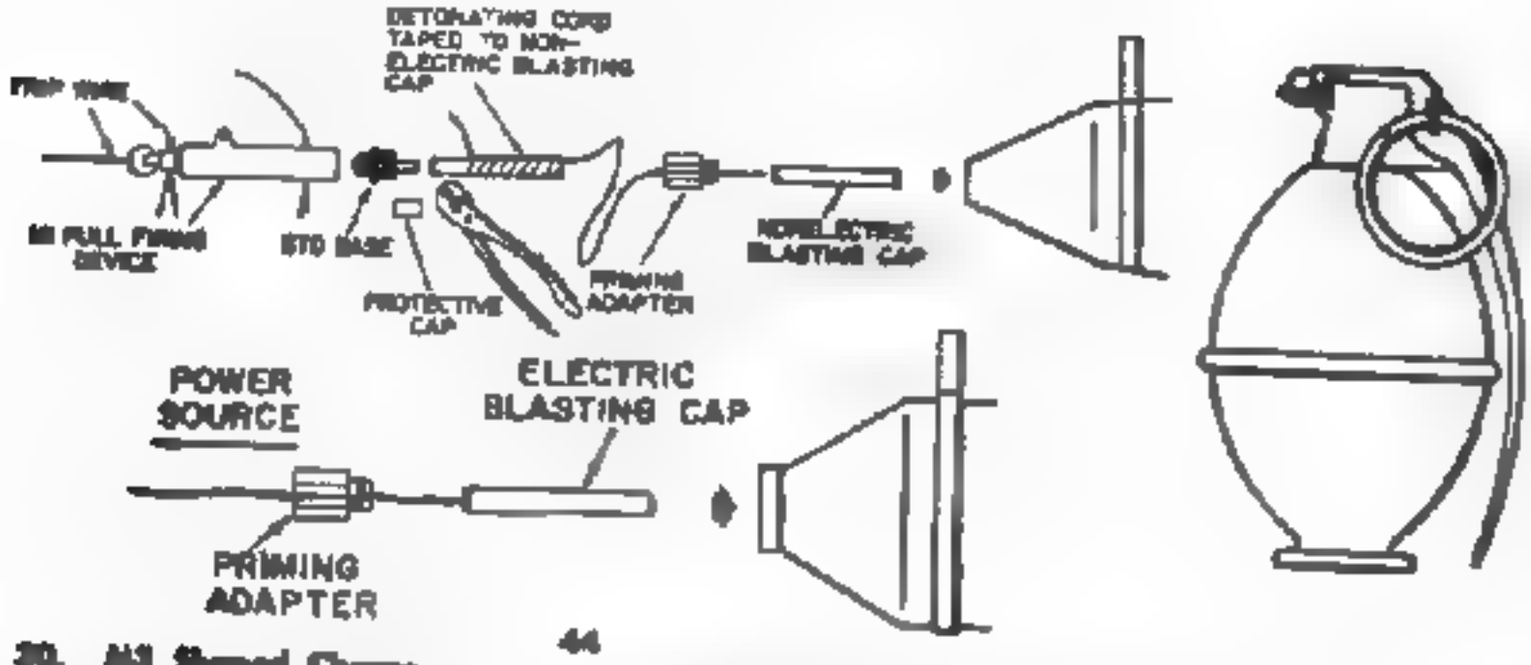


43

29. M2A3 Shaped Charge

This charge consists of a conical top, conical liner, integral standoff, threaded cap well, and 11½ pounds of explosive. It may be primed in three ways: by a standard firing device; a standard firing device, nonelectric blasting cap, length of detonating cord, priming adapter, and nonelectric blasting cap; and a priming adapter and electric blasting cap connected to power source.

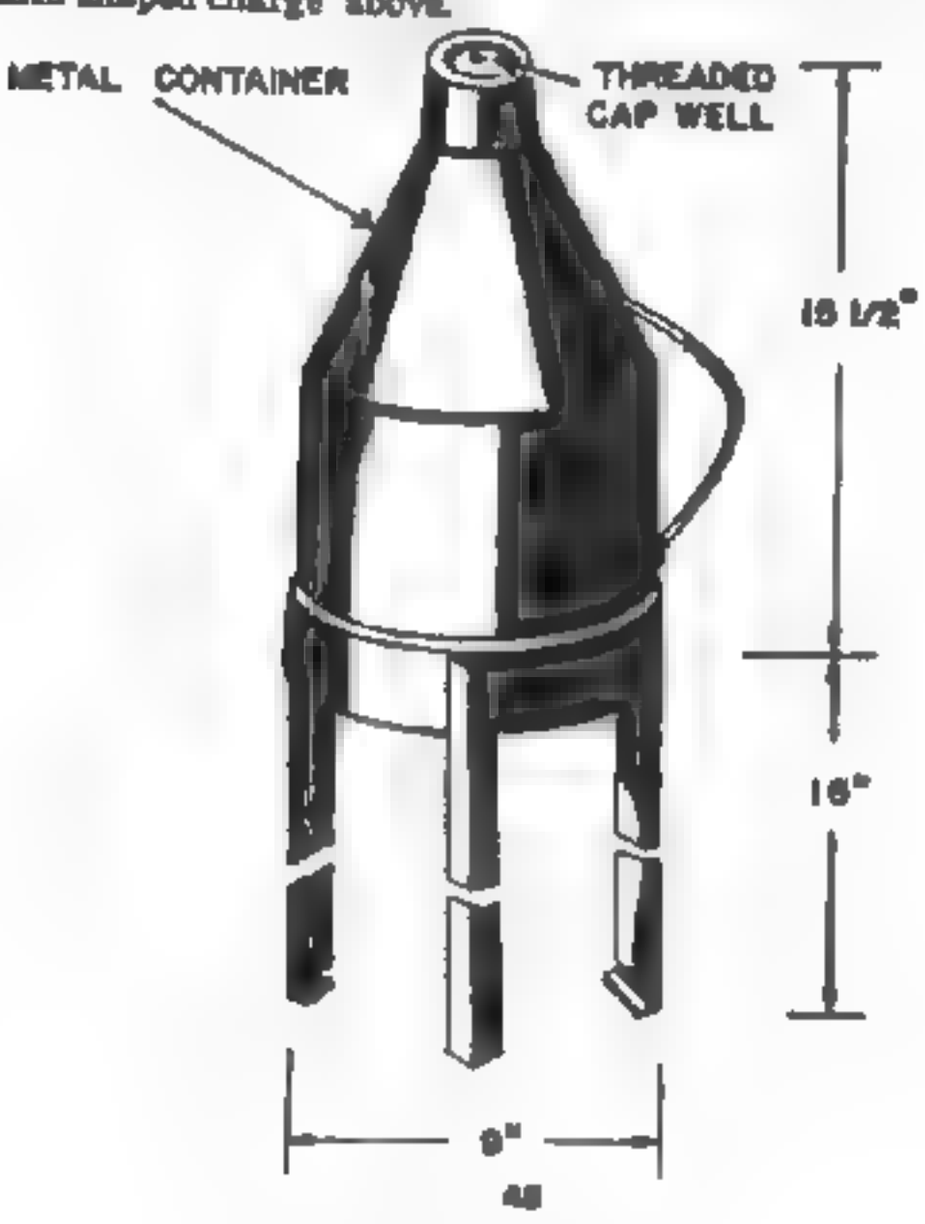




44

30. M3 Shaped Charge

The M3 shaped charge is a metal container with a conical top, conical liner, threaded cap well, 30 pounds of explosive, and a metal tripod standoff. It may be primed in the same manner as the M2A3 shaped charge above.



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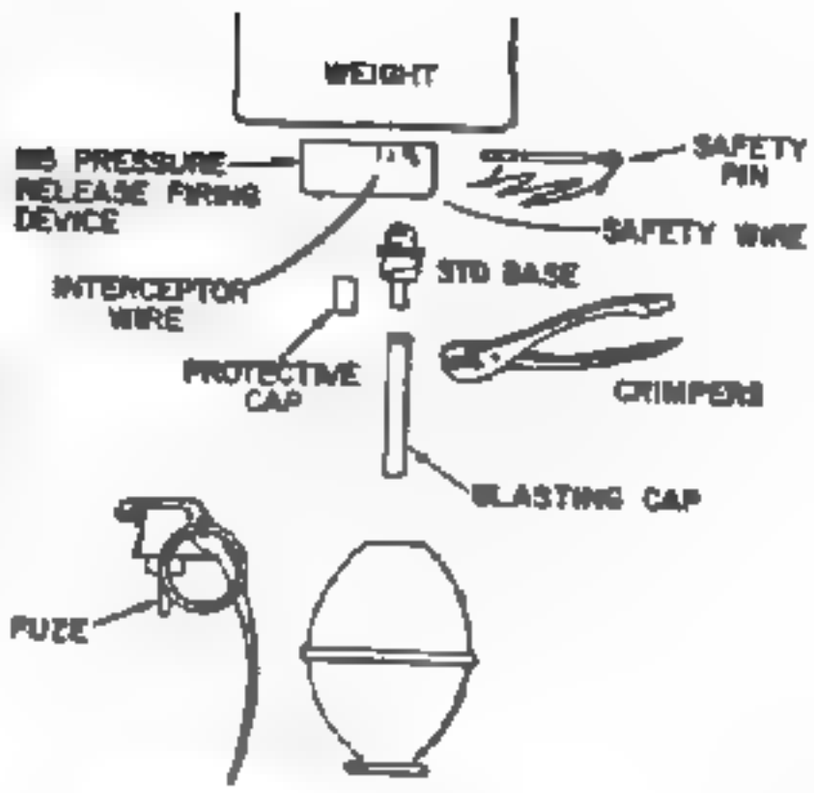
Section III. MISUSES

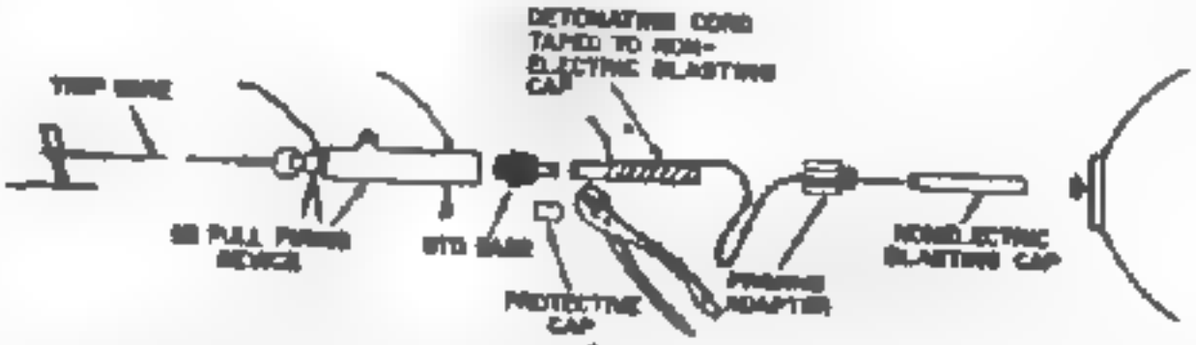
31. Introduction

Hand grenades, bombs, and mortar and artillery ammunition have wide application as improvised explosive charges. The only portion of these useful in boobytrapping, however, are the container and its explosive filler. The fuze is replaced by a standard firing device and an M10 universal destructor—an adapter designed especially for this purpose. The number and type of missiles useful in boobytrapping, however, are not limited to the examples given below.

32. Hand Grenade

The M26 hand grenade, an improved model, consists of a thin metal body lined with a wire-wound fragmentation coil, fuze, and composition B explosive charge. It has a variety of applications to boobytrapping. The fuze is removed and a standard firing device is screwed directly into the fuze well or remotely connected by a length of detonating cord, priming adapter, and a nonelectric blasting cap.





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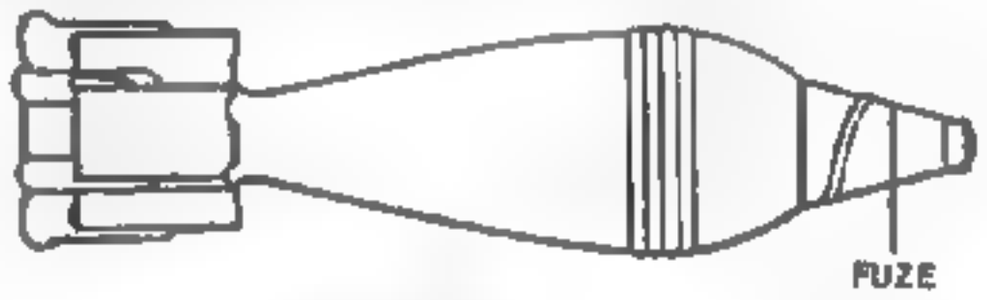
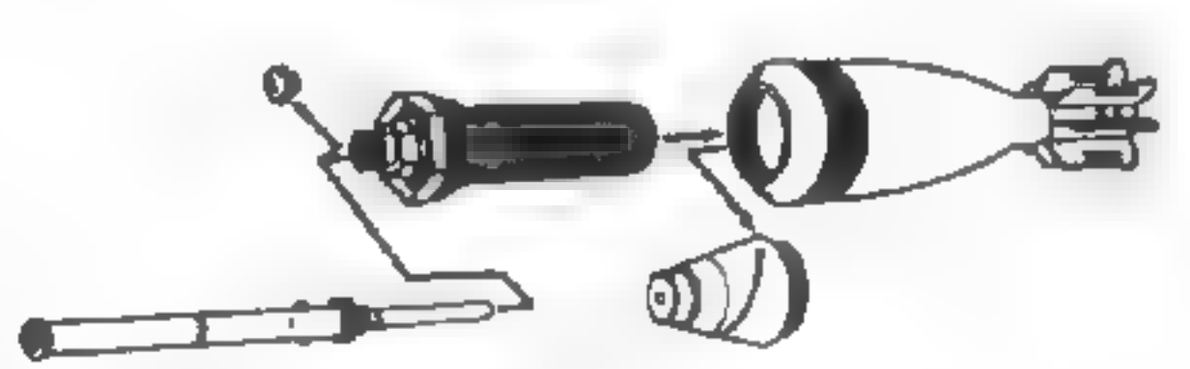
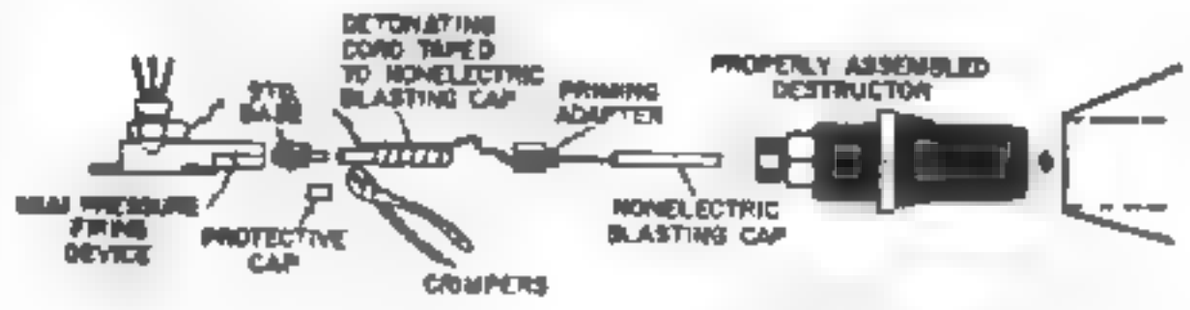
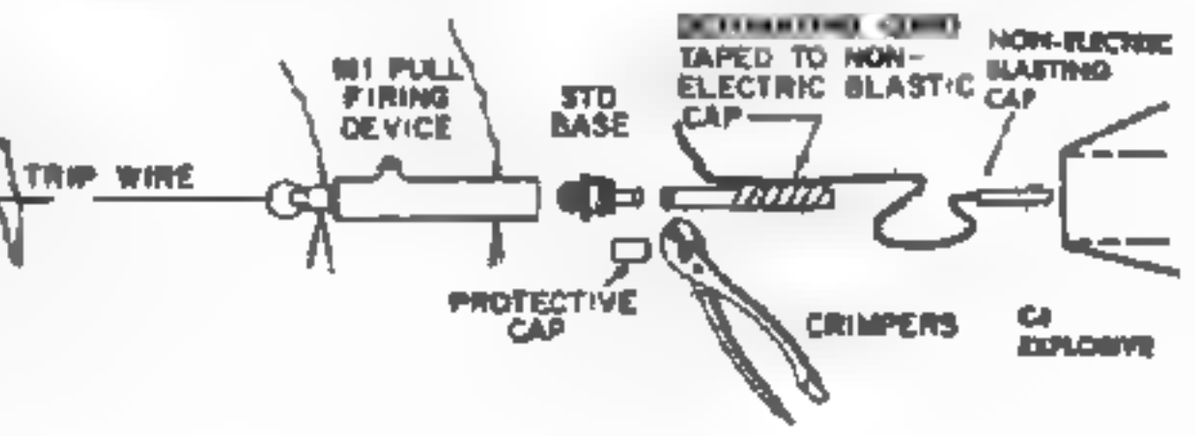
33. 81MM Mortar Shell

This is converted by replacing the fuze with a standard firing device and a properly assembled destructor or by a firing device, length of detonating cord, priming adapter, nonelectric blasting cap, and a properly assembled destructor. If a destructor is not available the detonating cord and nonelectric blasting cap are packed firmly in the fuze well with C4 explosive.









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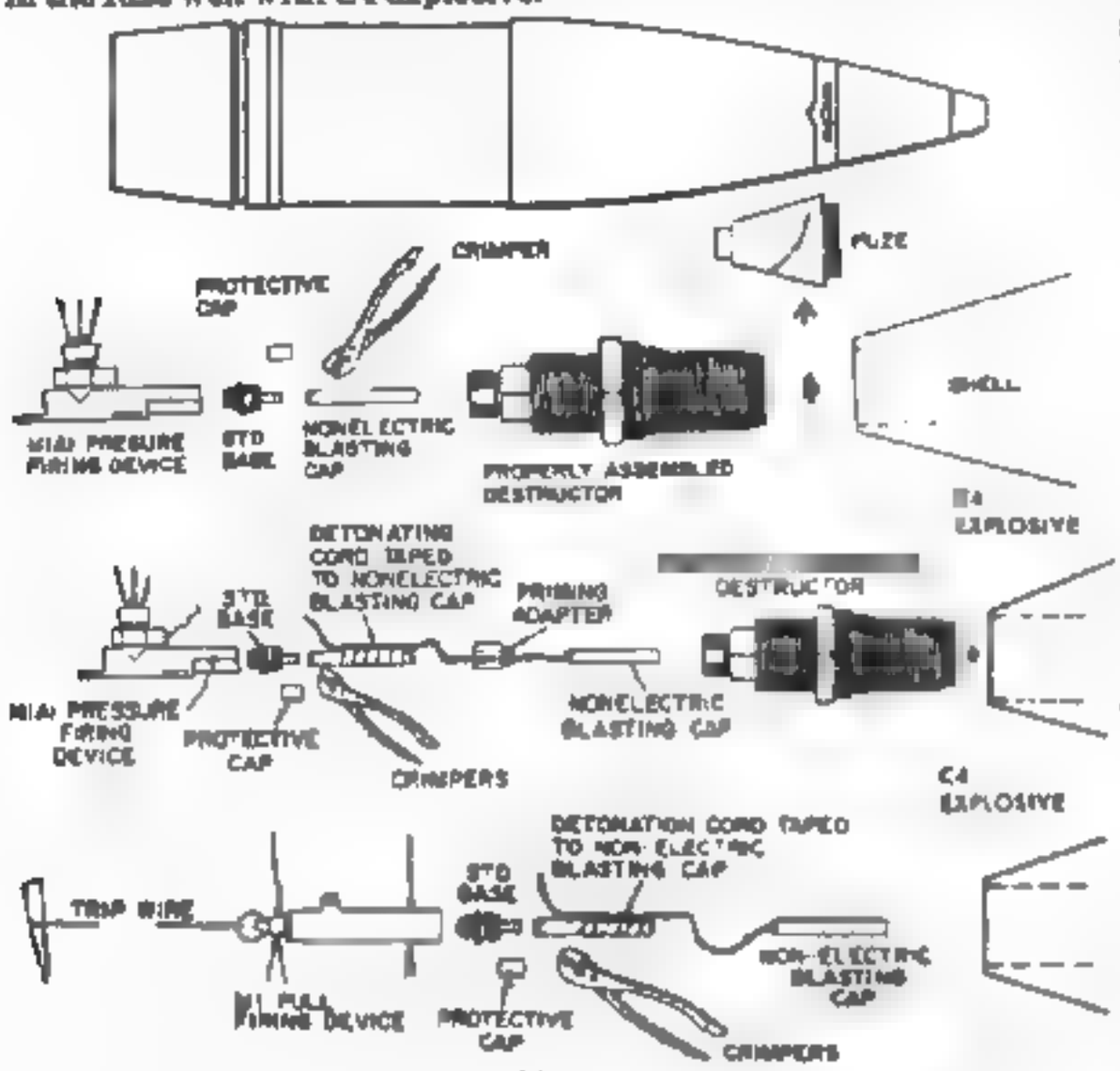
34. High Explosive Shell

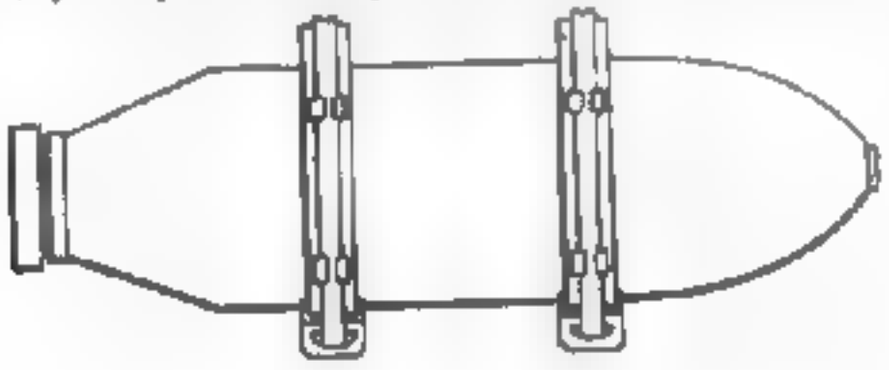
The high explosive shell is readily adapted to boobytrapping. The fuze is removed and replaced by a standard firing device and a properly-assembled destructor or a standard firing device, length of detonating cord, priming adapter, nonelectric blasting cap, and a properly-assembled destructor. If a destructor is not available, the detonating cord and nonelectric blasting cap are packed firmly in the fuze well with C4 explosive.

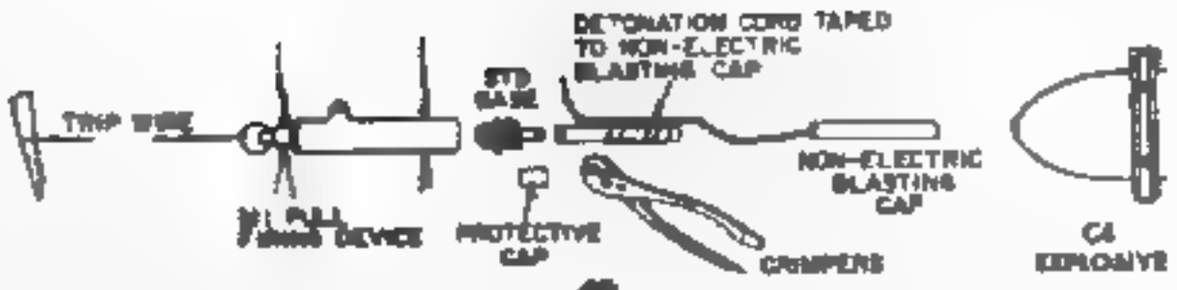


48

35. Bombs

These are adapted to boobytrapping in the same manner as high explosive and mortar shells. They are primed by replacing the fuze with a standard firing device and a properly-assembled destructor, or with a standard firing device, length of detonating cord, priming adapter, nonelectric blasting cap, and a properly-assembled destructor. If a destructor is not available, the detonating cord and blasting cap are packed firmly in the fuze well with C4 explosive.





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36. Antitank Mines

A land mine may be used as the main charge in a boobytrap by removing the fuze and attaching a standard pull or pressure-release firing device in an auxiliary fuze well.

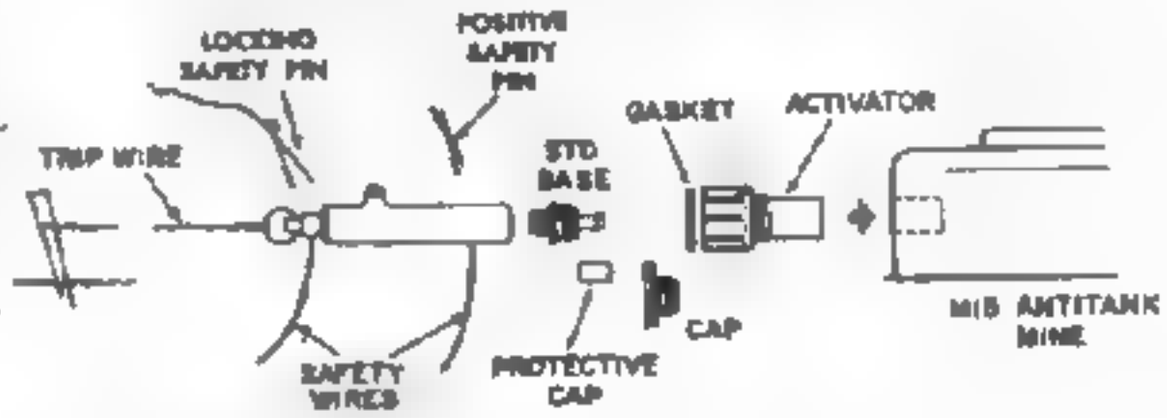
a. Pull.

(1) Remove locking safety cotter pin in M1 pull firing device and replace with length of thin wire. Bend wire slightly to prevent dropping out.

(2) Remove positive safety cotter pin and replace with length of thin wire. Bend wire slightly to prevent dropping out.

(3) Remove plastic protective cap from standard base.

(4) Assemble firing device, activator, and mine.



b. Pressure-Release.

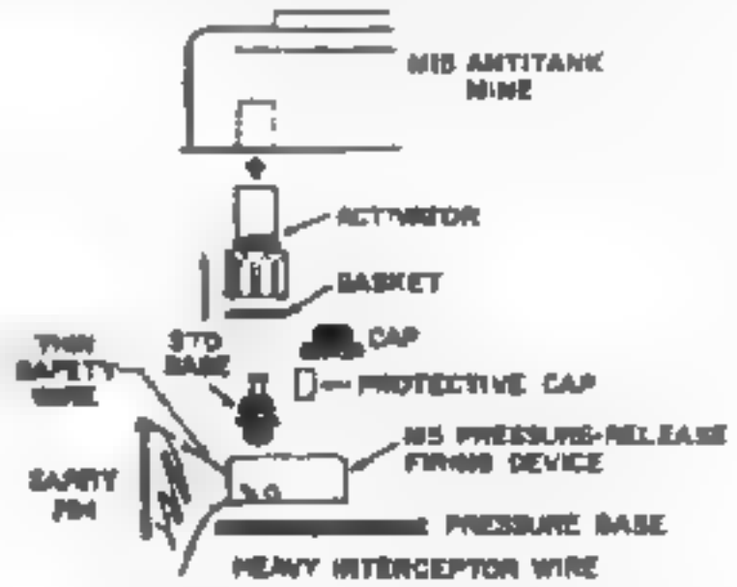
(1) Insert length of heavy wire in interceptor hole in M5 pressure-release firing device. Bend wire slightly to prevent dropping out.

(2) Withdraw safety pin and replace with length of thin wire. Bend wire slightly to prevent dropping out.

(3) Remove plastic protective cap from standard base.

(4) Assemble firing device, activator, and mine.

Note. The firing device must be set on a firm base. A piece of masonite is issued with the M5 for this purpose.



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CHAPTER 4

CONSTRUCTION TECHNIQUES

Section I. Boobytrapping Mines in Minefields

37. Tactical Purpose

Antitank mines laid in mine fields are boobytrapped (or activated) primarily to make breaching and clearing as dangerous, difficult, and time consuming as possible in order to confuse, demoralize, and delay the enemy. Most standard U.S. antitank mines and many foreign antitank mines have auxiliary fuse wells for this purpose. See FM20-32 for more detailed information.

38. Methods

U.S. standard antitank mines are generally boobytrapped by means of a pull or a pressure-release firing device, or both, if

desirable.

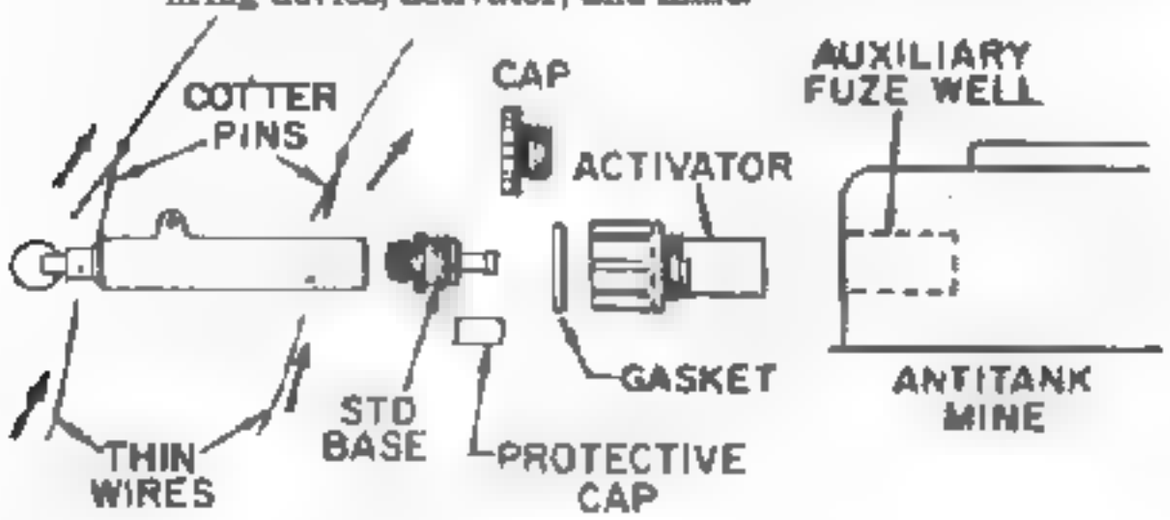
a. *Pull.* Dig hole to proper depth to bury mine on firm foundation with top of pressure plate even with or slightly above ground level. Arm mine before boobytrapping.

(1) *Installing.*

(a) Remove locking safety cotter pin and replace with length of thin wire. Bend wire slightly to prevent dropping out.

(b) Remove positive safety cotter pin and replace with length of thin wire. Bend wire slightly to prevent dropping out.

(c) Remove protective cap from standard base and assemble firing device, activator, and mine.



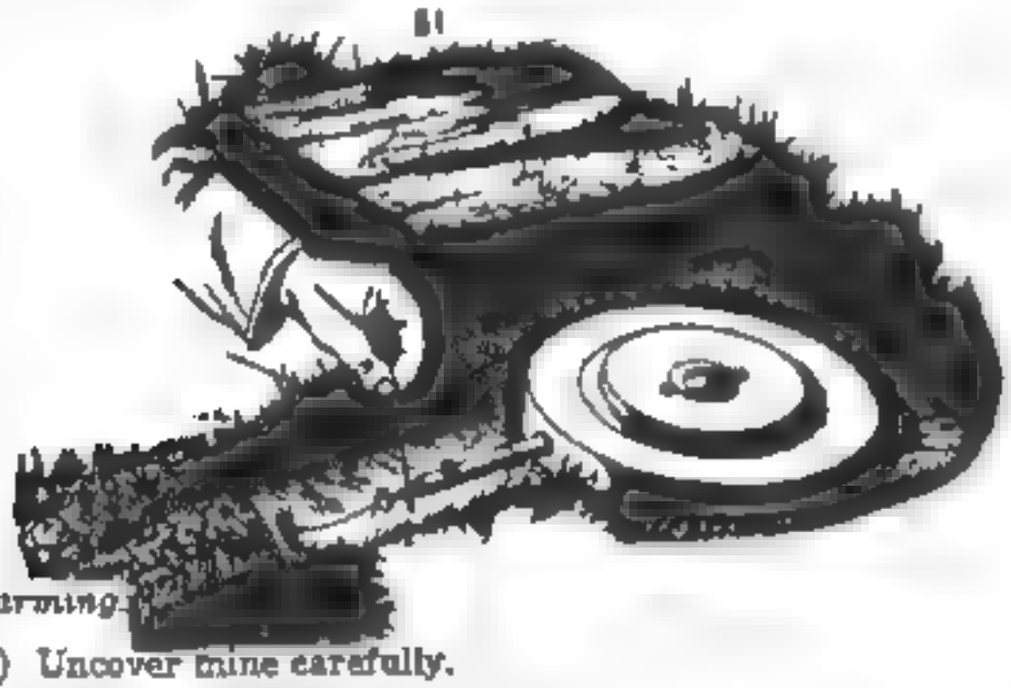
(2) *Arming.*

(a) Anchor one end of trip wire to stake and fasten the other to pull ring.

(b) *Remove locking safety wire first.*

(c) Remove positive safety *last.*

(d) Camouflage.



(3) *Disarming.*

(a) Uncover mine carefully.

(b) Locate boobytrap assembly.

(c) Replace positive safety *first*, then locking safety.

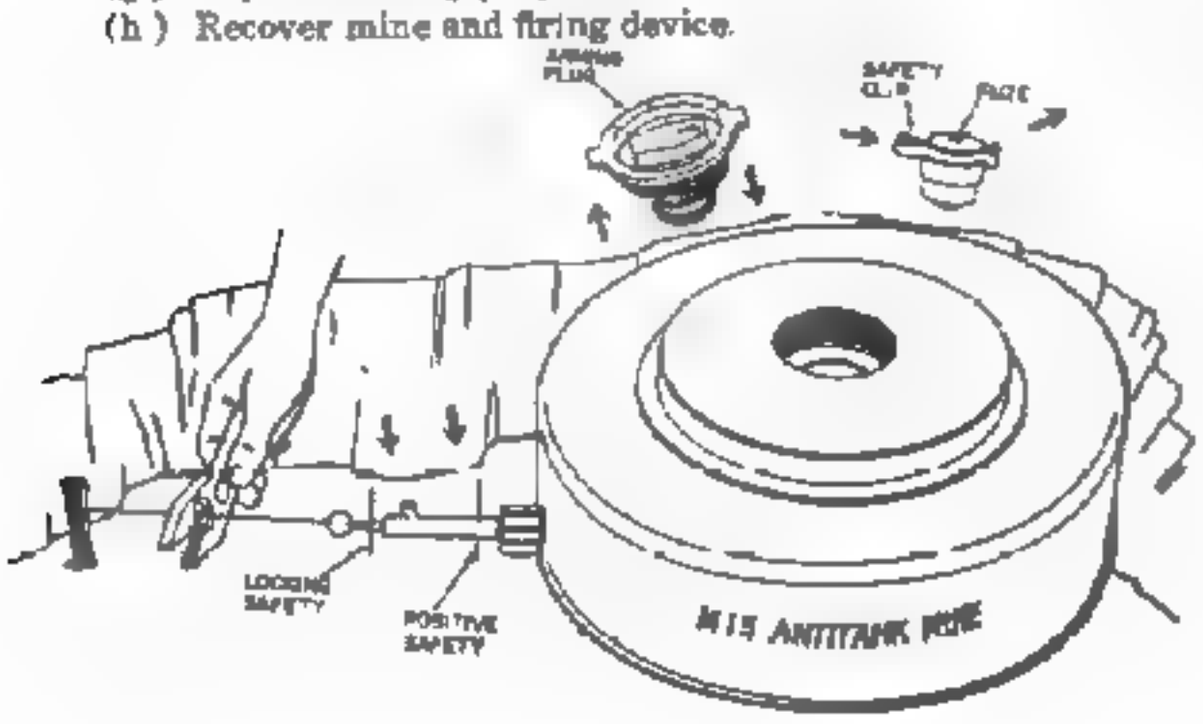
(d) Cut trip wire.

(e) Turn arming dial of mine to *safe* and remove arming plug.

(f) Remove fuse and replace safety clip.

(g) Replace arming plug.

(h) Recover mine and firing device.



b. *Pressure-Release.* Dig hole to proper depth to bury mine on firm foundation, with top of pressure plate even with or slightly above ground level.

(1) *Installing.*

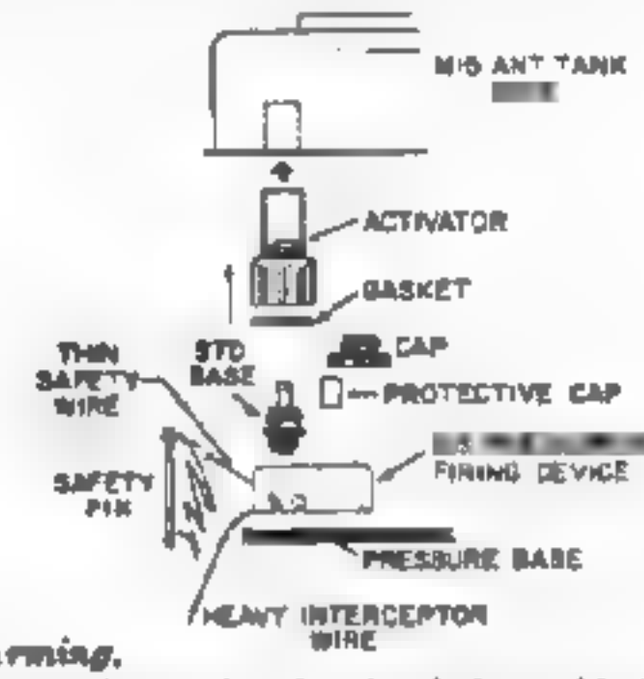
(a) Insert length of heavy wire in interceptor hole. Bend wire slightly to prevent dropping out.

(b) Remove safety pin. Apply pressure on release plate until pin comes out easily.

(c) Insert length of light wire in safety pin hole and bend slightly to prevent dropping out.

(d) Remove protective cap from standard base and assemble firing device, activator, and mine.

(e) Place mine and firing assembly in hole, using pressure board to insure a solid foundation for firing device.



(2) *Arming.*

(a) Camouflage mine, leaving hole at side to remove safeties.

(b) Carefully remove thin safety wire *first*, then the interceptor wire.

(c) Complete camouflage.

(3) *Disarming.*

(a) Uncover mine carefully.

(b) Locate boobytrap assembly.

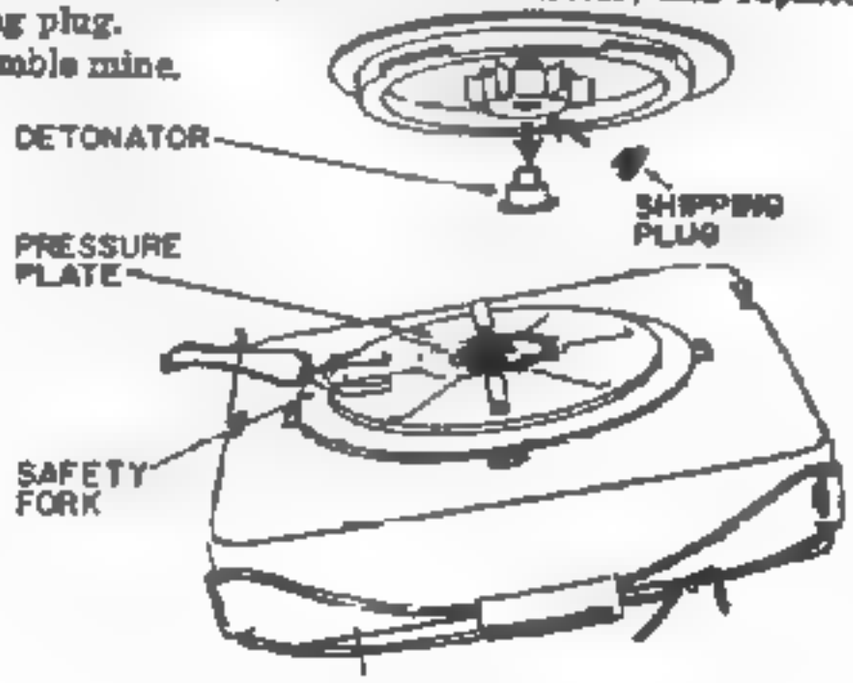
(c) Insert length of heavy wire in interceptor hole.

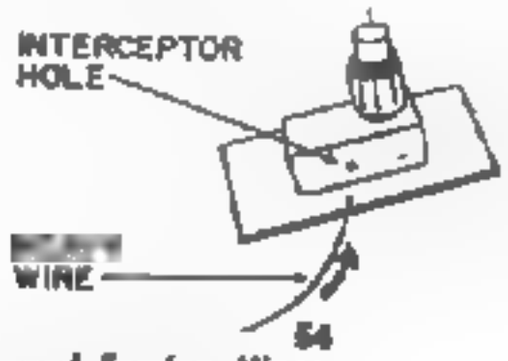
(d) Turn dial on pressure plate to "S" (safe) and replace safety fork.

(e) Recover mine and firing device assembly.

(f) Remove pressure plate, unscrew detonator, and replace shipping plug.

(g) Reassemble mine.





39. Boobytrapped Foreign Mines

a. Antitank Mines.

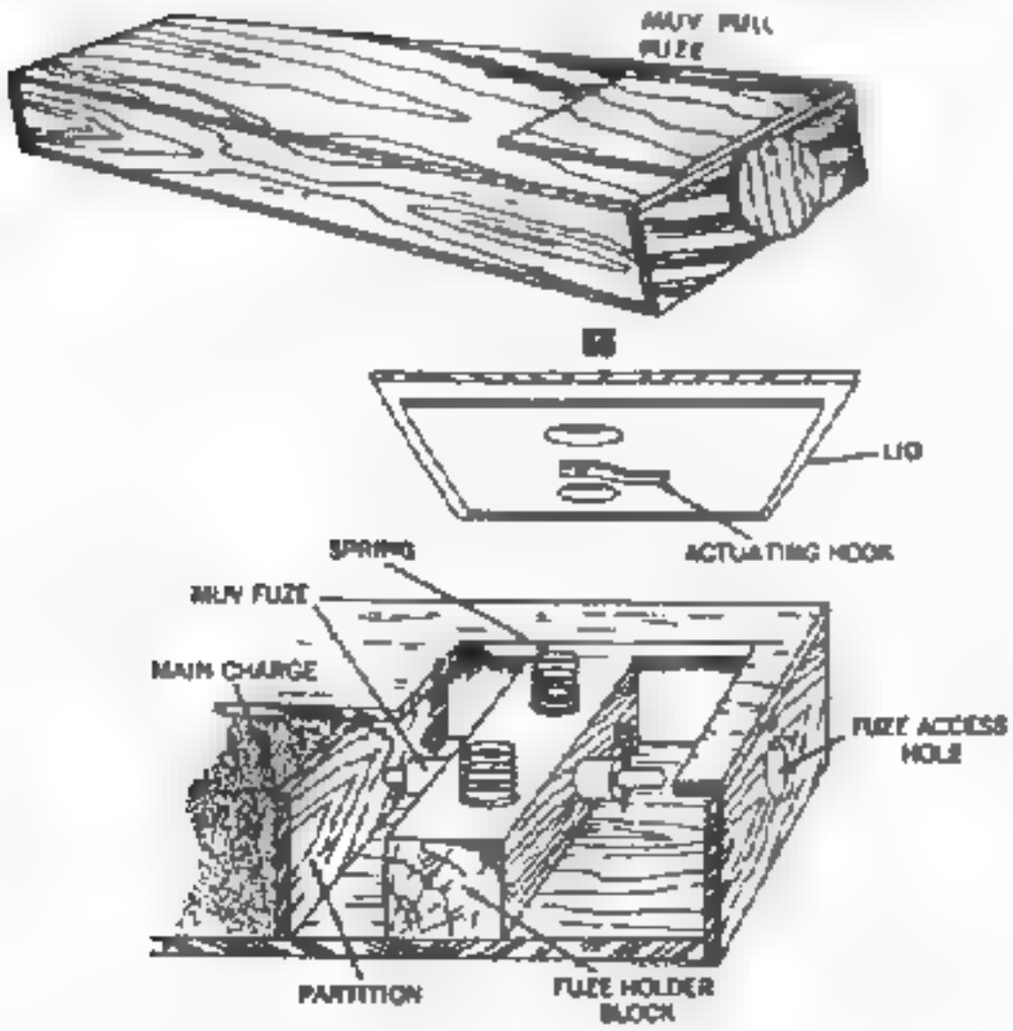
The Communist European and Asiatic armies boobytrap mines in a much different fashion from that of the U.S. and other NATO countries. The Germans in World War II used both special antilift devices and antidisturbance fuzes, one of which has been copied by the French.

(1) *Antilift devices.*

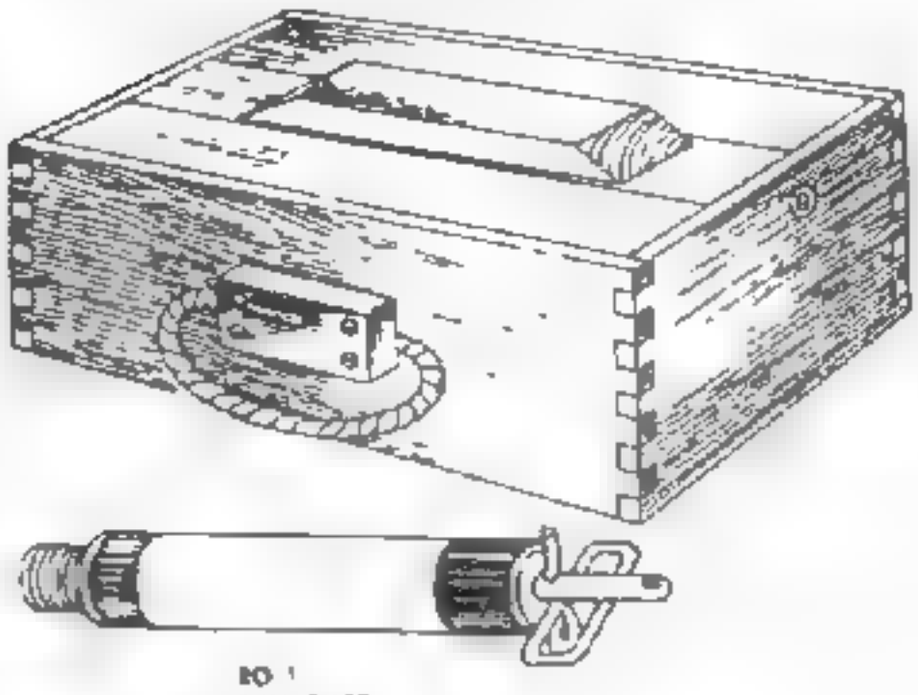
(a) Russia

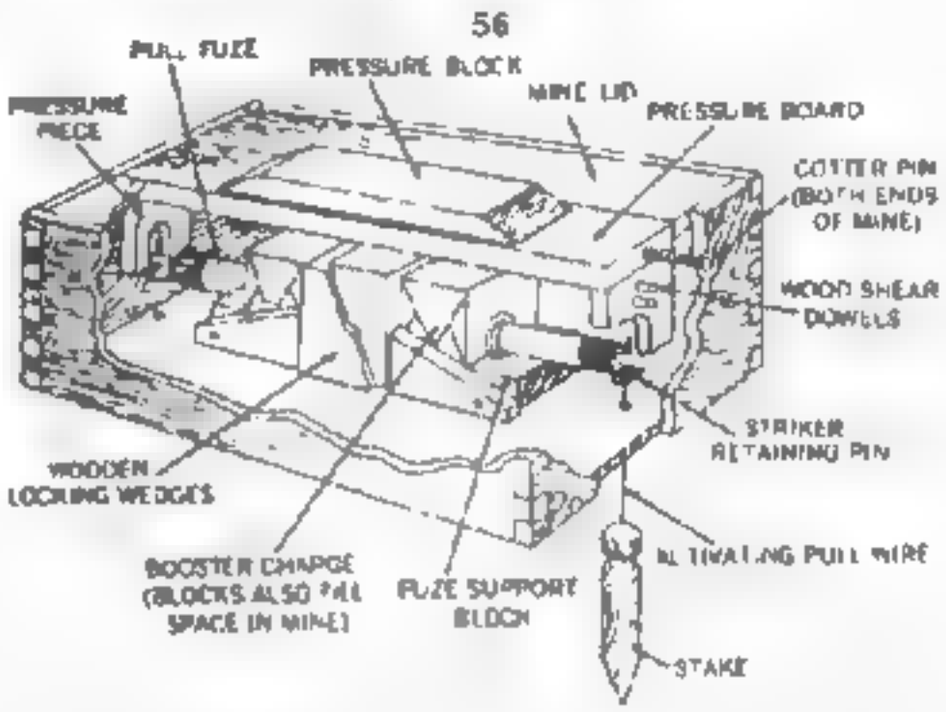
1. The Russians, Communist Chinese, and North Koreans boobytrapped wooden antitank mines by laying two of them, one on top of the other, in the same hole. The mines were connected by an MUV pull fuze and a pull wire, so that the bottom mine would detonate when the top mine was lifted.

2. The Russians in World War II also had a more sophisticated method—a special wooden antilift device, placed under the mine. This, however was readily located by probing. It consisted of an outer case, a charge, an MUV pull fuze, a pressure release lid supported on two coil springs, and a fuze access hole. Lifting the mine initiated the antilift. *This device is too dangerous to disarm.* Even though the pressure-release might be secured by a rope or length of wire, the chances of additional pull wires and boobytrap charges are too great to risk. Also deterioration of the wooden case from prolonged burial adds to the difficulty. *The best procedure is to blow all wooden antitank mines and antilifts in place.*



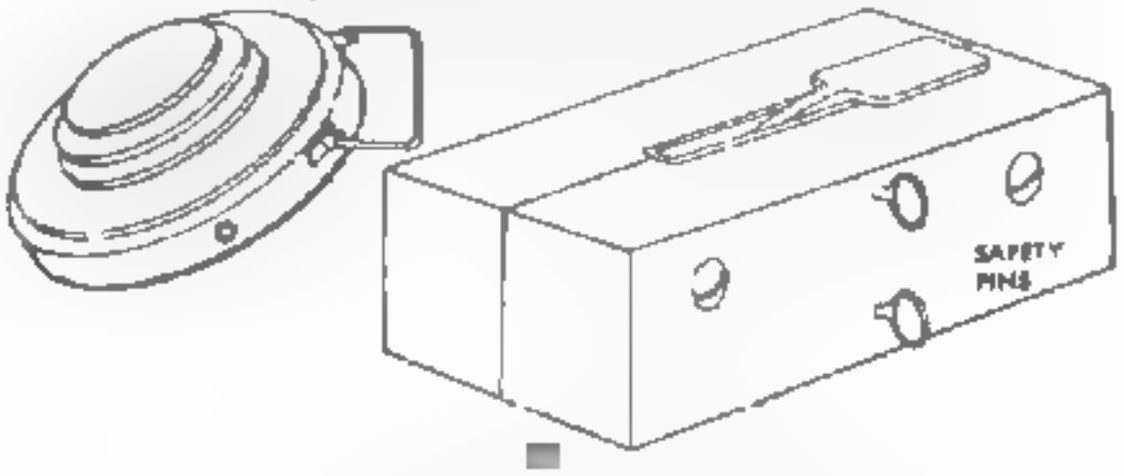
(b) Czechoslovakia. This satellite country has a wooden antitank mine (PT-Mi-D) that may prove extremely hazardous to breaching and clearing parties. Having an RO-1, pull fuze in each end, it is easily boobytrapped by means of wire anchored to a stake underneath the mine and extended through a hole in the bottom of the case to the fuze pull pin.



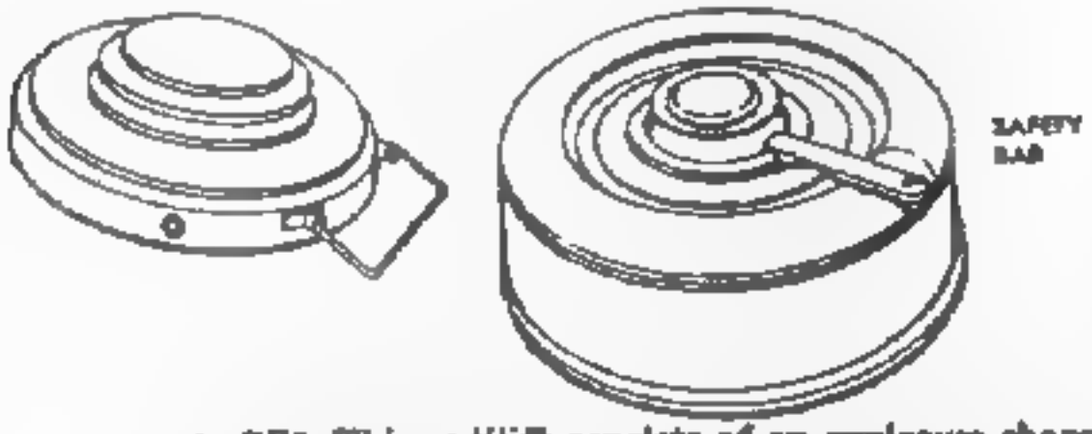


(c) World War II Germany The German armies had several pressure-release devices for boobytrapping antitank mines. In a future war in Europe, these or facsimiles may appear on any battlefield

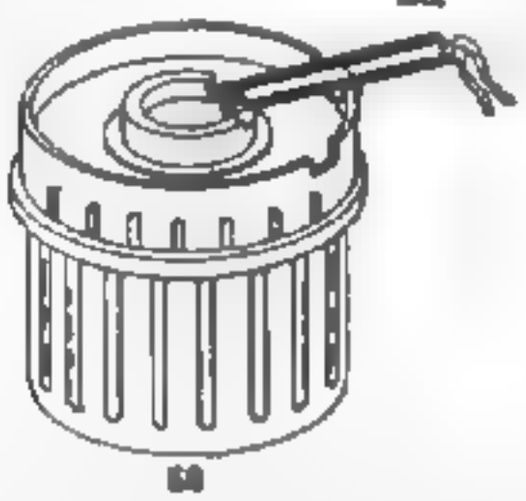
1 *Nepolite all explosive antilift.* This consisted of two oblong blocks of moulded explosive joined together with brass bolts and recessed to contain the metal striker assembly. It may be disarmed by inserting a safety in the lower safety pin hole.



2 *EZ. SMi (EZ 44).* This device consists of an explosive charge, a pressure-release firing mechanism, a safety bar and a metal case. When the safety bar is removed, the device arms itself by means of clockwork inside the case. *This device cannot be disarmed.*

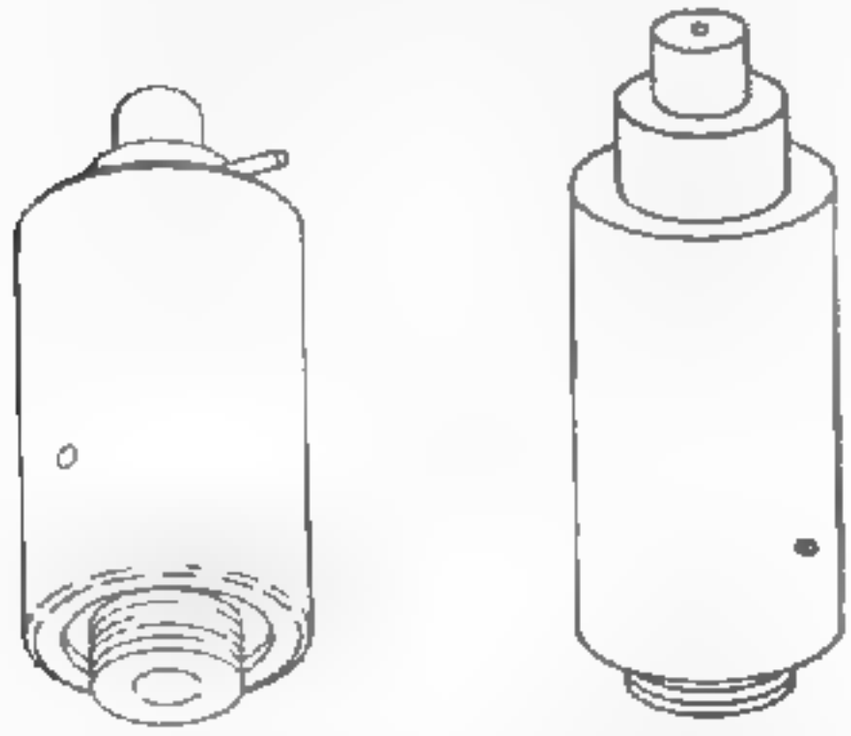


g SF5. This antilift consists of an explosive charge, pressure-release striker assembly, safety bar, and chemical arming equipment. A turn of the safety bar crushes the glass vial, releasing the chemical to dissolve the safety pellet. *This device cannot be disarmed.*

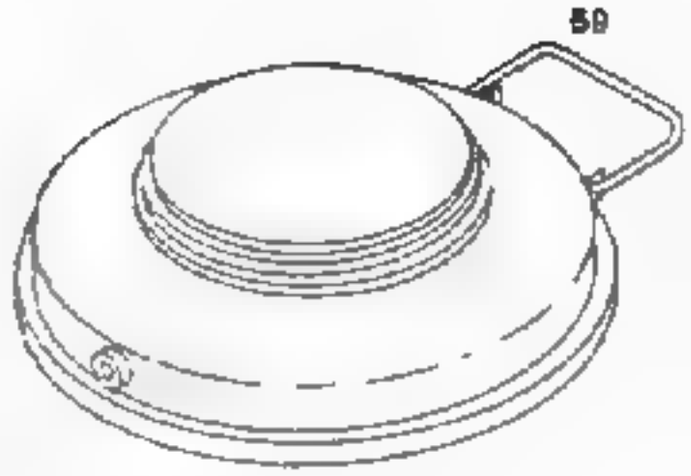


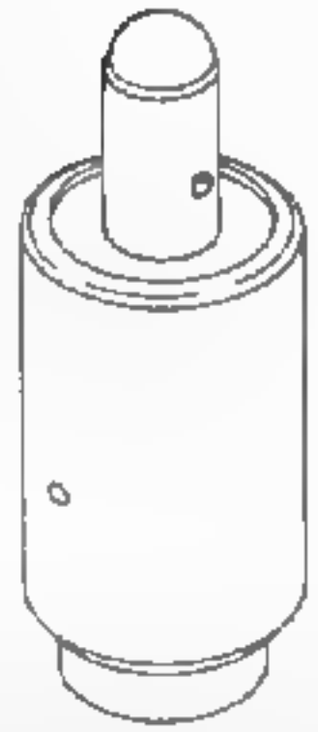
(2) *T. Mi. Z 43 and T. Mi Z 44 antidisturbance fuzes.*

(a) *Germany.* In addition to several antilift devices, the Germans developed two antidisturbance fuzes initiated by pressure or pressure-release for activating Teller mines 42 and 43. To arm, the fuze is placed in the fuze well and the pressure plate screwed down on top of the fuze, shearing the arming pin. Removal of the pressure plate initiates the pressure-release mechanism and detonates the mine. Although the T. Mi. Z 44 was an experimental model that never reached the field, copies of both fuzes are now in use in several European armies. *Mines armed with these fuzes can neither be identified by size, shape, marking, or color of the case, nor be disarmed.*



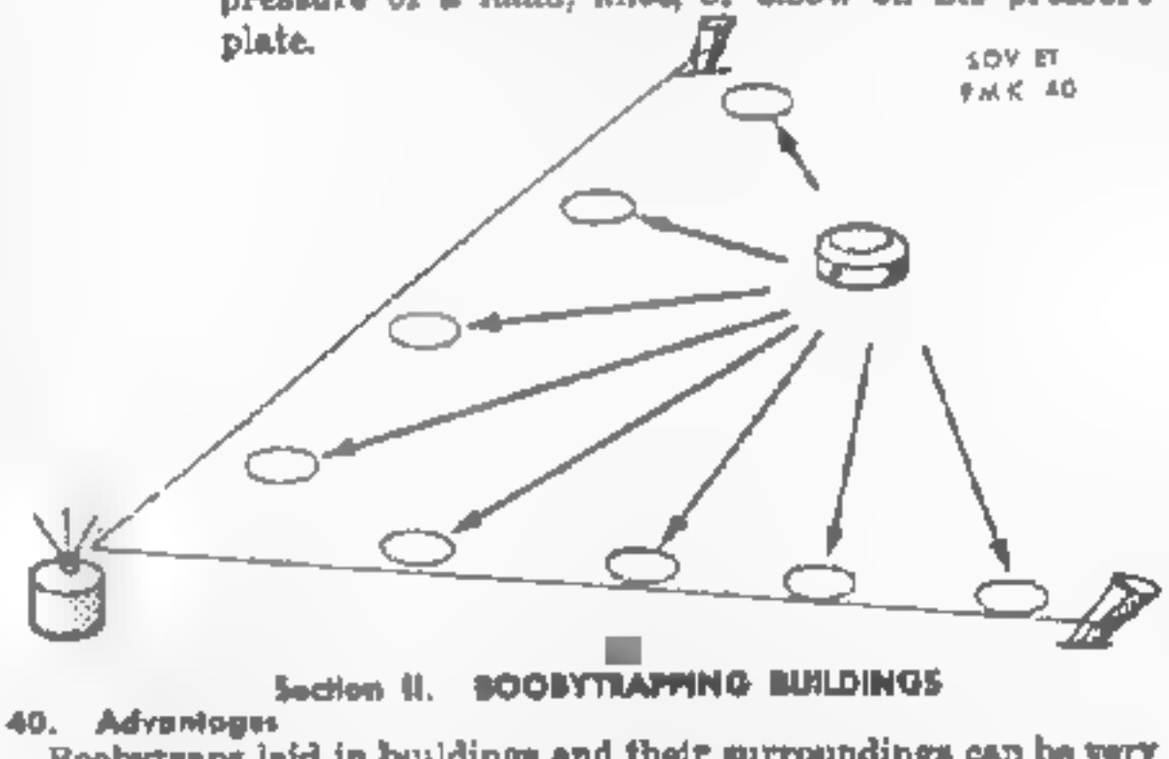
(b) *France.* The French have a copy of the T. Mi. Z 43 antidisturbance (pressure and pressure-release) fuze, and Teller mine 43, named models 1952 and 1948 respectivaly. The fuze is placed in the fuze well and the pressure plate screwed down on top, shearing the arming pin. Removing the pressure plate actuates the pressure-release element, detonating the mine.





b. Antipersonnel Mines.

Antipersonnel mines are laid in antitank minefields to halt and delay enemy troops and make breaching and clearing as difficult, dangerous, and time consuming as possible. Enemy mine layers may increase this harrassment substantially by laying small blast type antipersonnel mines near the anchors and along the trip wires, which, according to procedure, must be traced from pull ring to anchor before cutting. These are extremely hazardous to breaching and clearing specialists who may detonate them unawares by the pressure of a hand, knee, or elbow on the pressure plate.



Section II. BOOBYTRAPPING BUILDINGS

40. Advantages

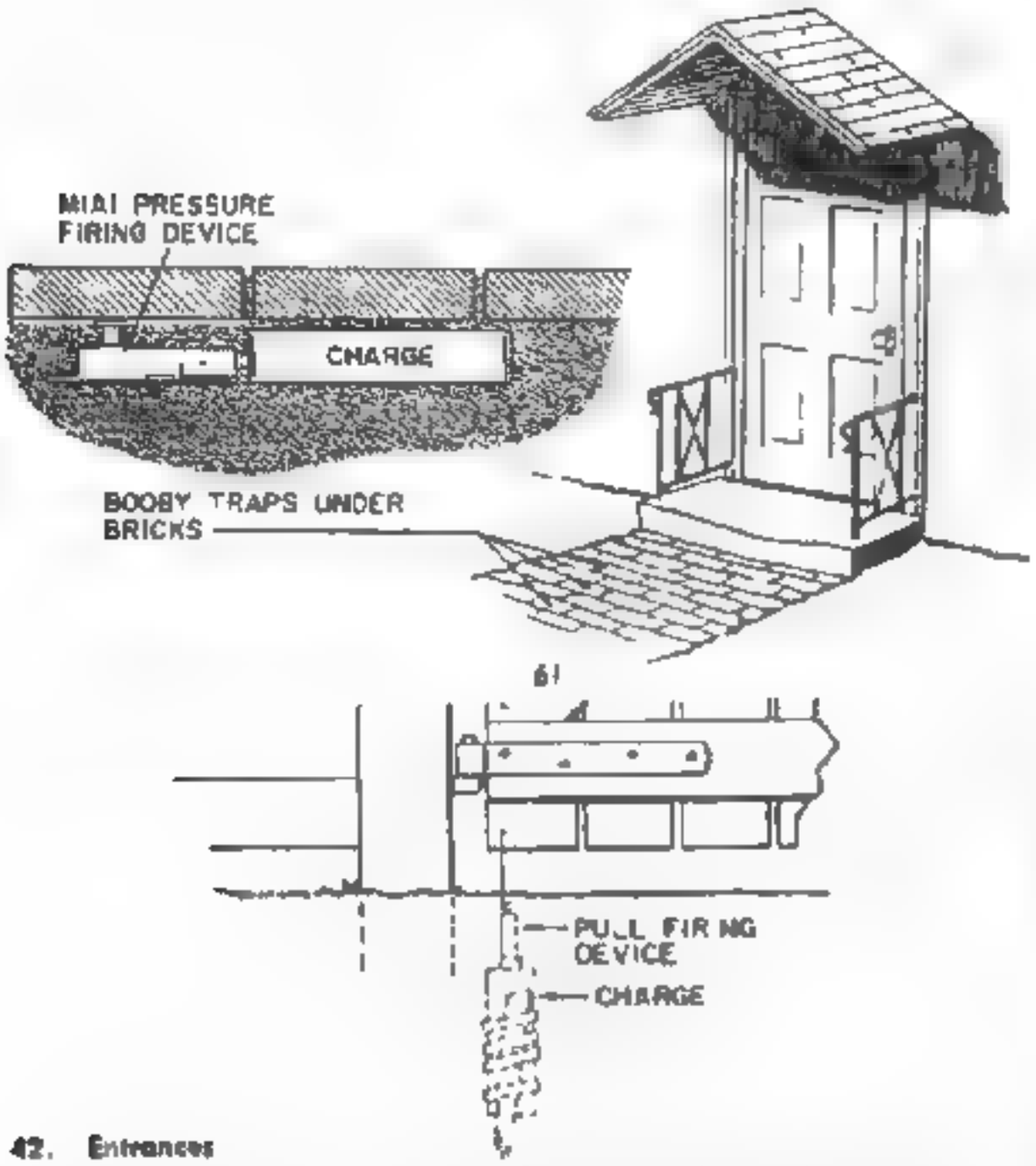
Boobytraps laid in buildings and their surroundings can be very effective. Buildings are very attractive to fighting men for they provide a degree of comfort and shelter from the elements. They are also useful for headquarters where plans may be made and communications carried on with greater dispatch.

41. Immediate Surroundings

a. Once a building has been occupied, it becomes the focal point for travel and communication from many directions. Thus the immediate vicinity becomes a potential location for boobytraps.

b. Dwellings in sparsely populated areas often have out buildings, wood piles, fruit trees, wells, fences with gates, walks, and other locations easily rigged to wound or destroy careless soldiers.

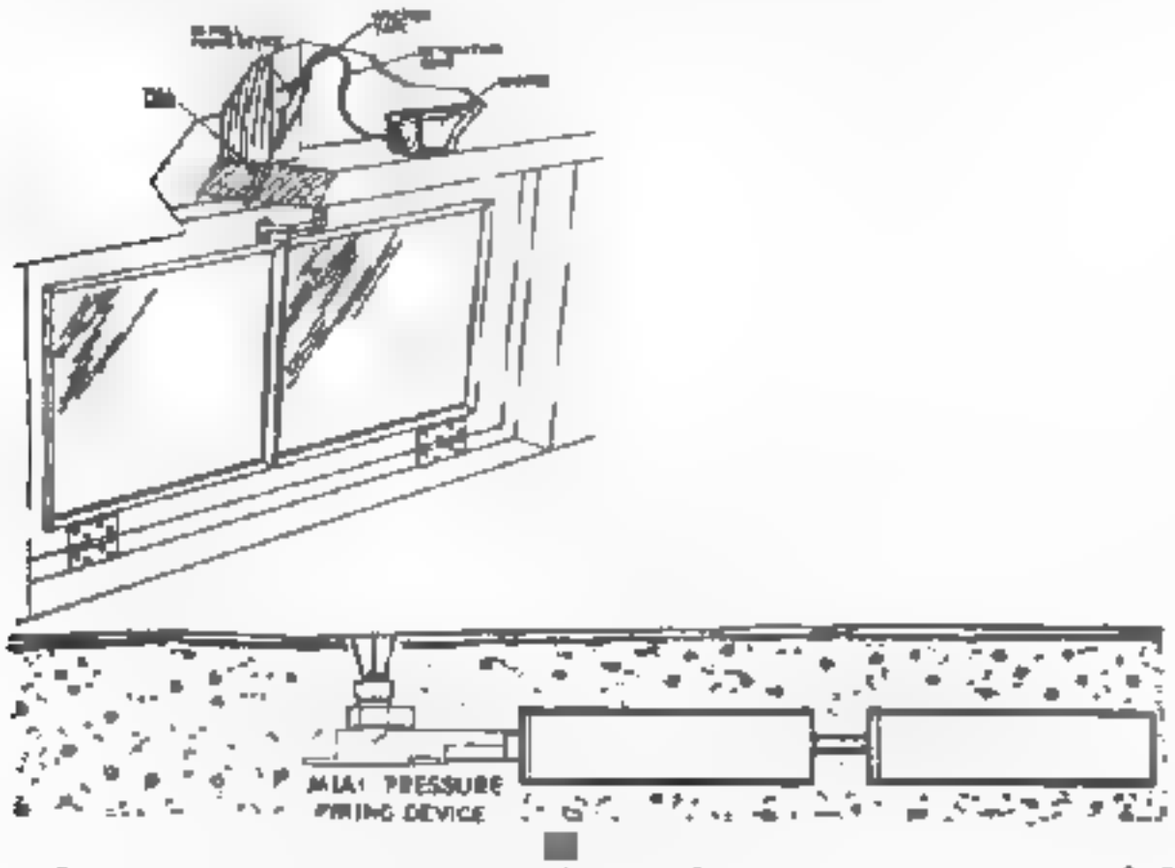
c. Delayed action charges detonated in buildings after they are occupied are extremely effective. Such charges, however, are difficult if not almost impossible to conceal, especially in large masonry and steel buildings, which may require a large quantity of explosive for serious damage or destruction. None but a most ingenious specialist, given time, help, and a wide selection of material can do this satisfactorily. In World War II, the Russians prepared such a boobytrap for the Germans. However, after long careful search, the charge and its clockwork fuze were located by means of a stethoscope. Small buildings, on the other hand, may be only moderately difficult to destroy by delayed charges.



42. Entrances

Curiosity prompts a soldier to investigate hurriedly an interesting building in his path. Women, loot, or mere inquisitiveness may be the motive. His rush to be the first inside makes all entrances excellent spots for boobytraps. For the foolish, a rigging connected to the front door, side door, or back doors may be sufficient. But for the experienced soldier, who may carefully seek entry to the basement first and then try to clear the building story by story, careful and ingenious effort may be required.

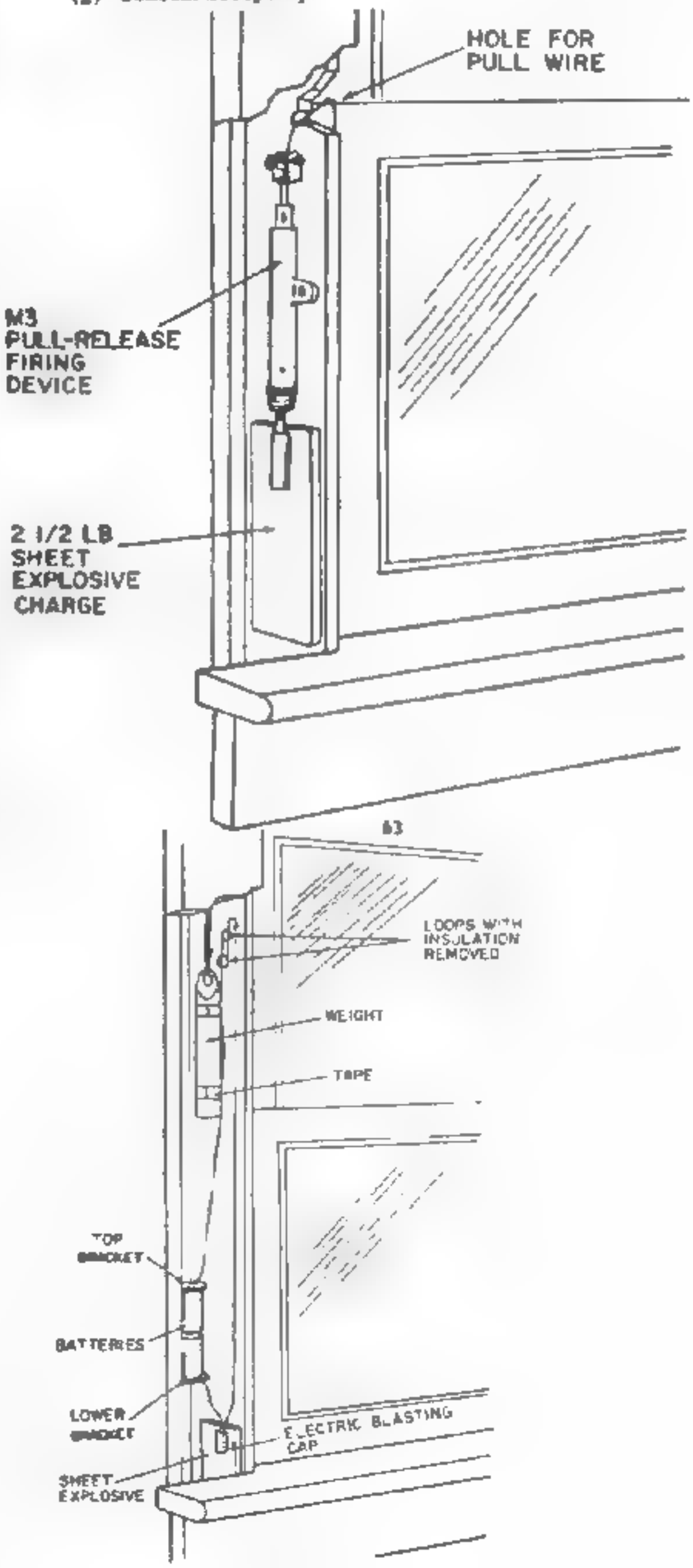
a. Basement Windows. Here boobytraps must be concealed to prevent detection by the enemy's breaking the pane or kicking out a door panel. Basement windows should be boobytrapped at the top or in the floor underneath.



b. Upper Floor Windows. Window charges are easier concealed in the weight box behind the jamb than in the wall or under the floor. Experienced hands can remove and replace window trim without obvious damage.

(1) *Nonelectric firing.*

(a) Assemble M3 pull-release firing device, standard base, and blasting cap.
(b) Place sheet explosive in weight box.
(c) Bore hole in side jamb for pull wire.
(d) Anchor one end of pull wire to window, and thread through hole in side jamb.
(e) Attach free end of pull wire to ratchet on firing device.
(f) Arm firing device.
(g) Conceal boobytrap.



(2) *Electric firing.*

(a) Fasten two metal brackets to side of weight box close enough to wedge two flashlight batteries between.
(b) Place sheet explosive charge in weight box.
(c) Insert electric blasting cap in charge.
(d) Cut one leg wire and attach to lower bracket.
(e) Cut other leg wire to proper length to twist an uninsulated loop on end and fasten to hang in place just above top of window weight.
(f) On a length of leg wire twist on uninsulated loop around the leg wire hanging above the weight. Thread other end through other uninsulated loop and fasten to top clamp Tape wire to window weight.
(g) Test circuit with ga ovonmeter first, then insert batteries between brackets.
(h) Concea. boobytrap.

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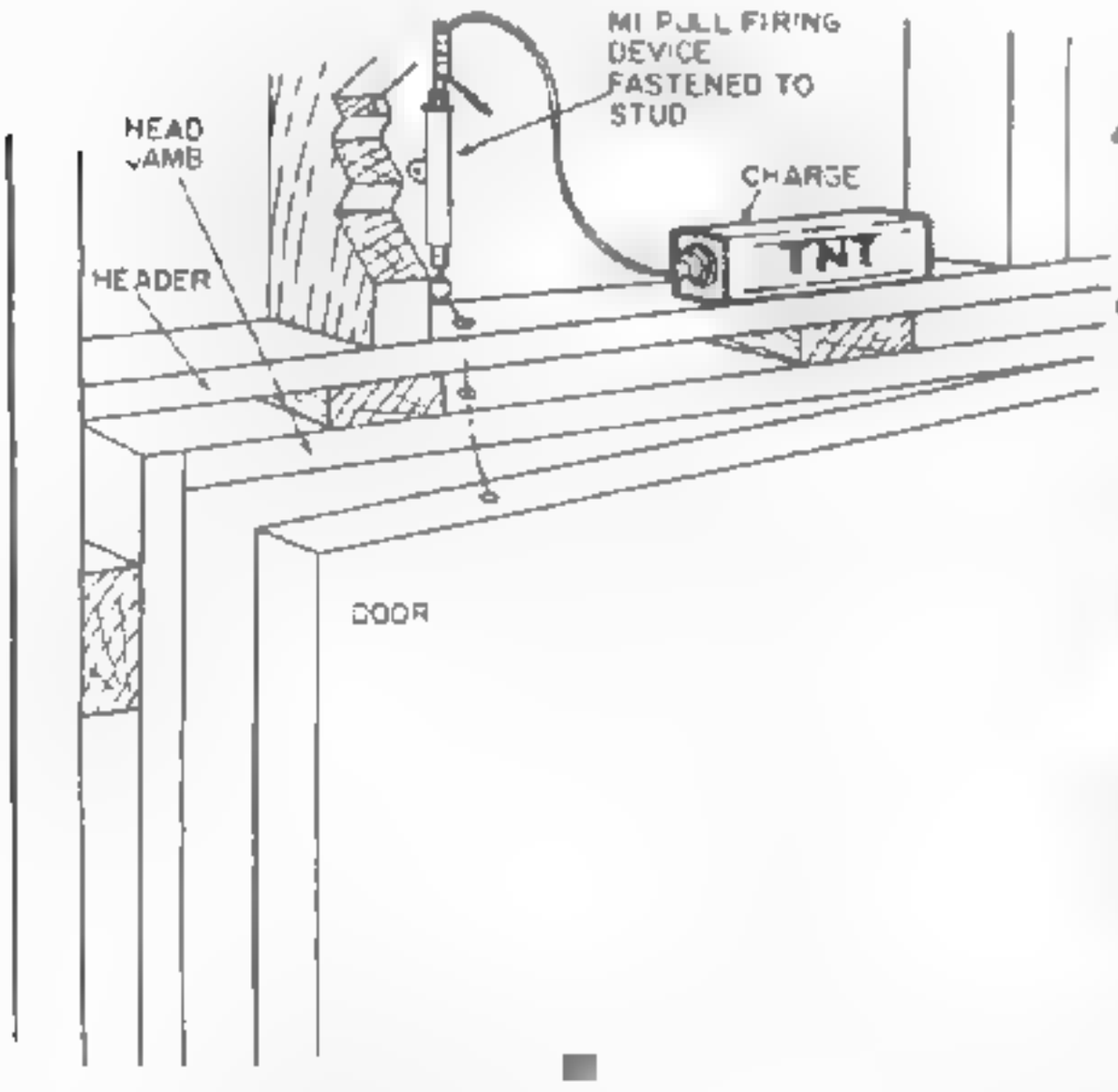
c. *Doors.* Improved detection methods have made the use of boobytraps on doors, with charges, firing devices, and wires exposed, a waste of time and material, except for purposes of deception. The best location is the head or side jamb, not the sill, which is often recommended. The sill is exposed, so that one experienced clearing unit may easily locate the rigging while in the jamb, it is concealed by the doorstop.

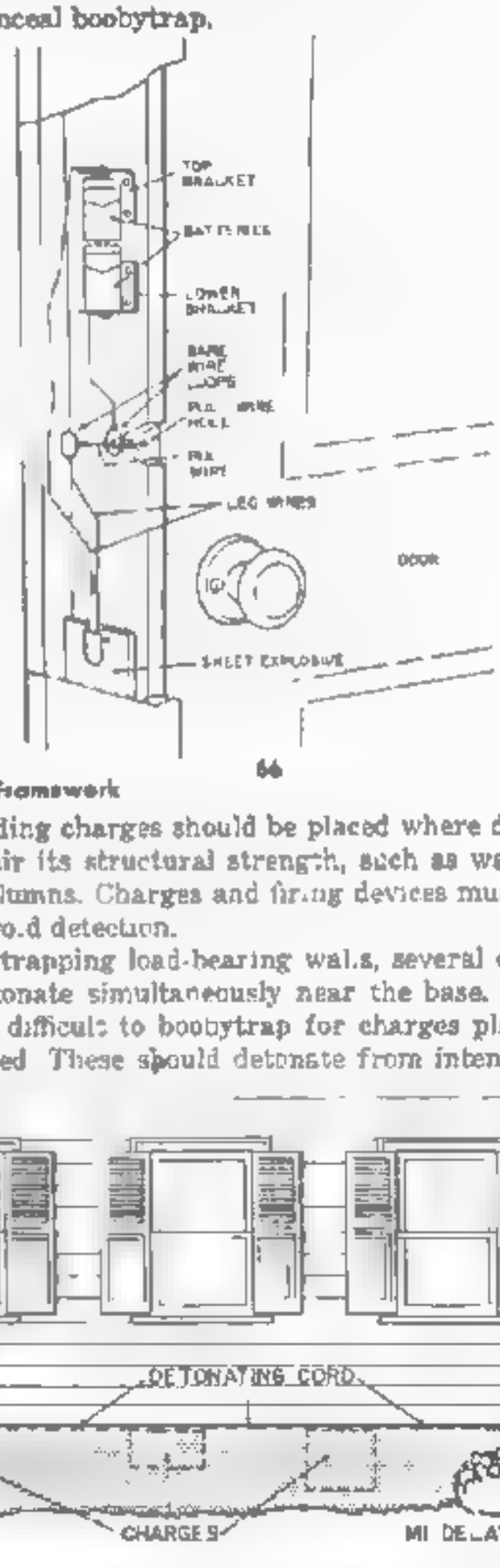
(1) *Head jamb rigging*

(a) Assemble M1 pull firing device, standard base, and nonelectric blasting cap.
(b) Assemble length of detonating cord, priming adapter, nonelectric blasting cap and explosive block.
(c) Attach firing device firmly to stud and tape free end of length of detonating cord to nonelectric blasting cap.
(d) Drill hole at proper place in header and head jamb.
(e) Anchor one end of pull wire at proper place on door and thread free end through holes
(f) Close door and attach pull wire to pull ring.
(g) Arm and conceal boobytrap.



(2) *Side jamb rigging.*

(a) Attach metal brackets to side jamb close enough to wedge two flashlight batteries between.
(b) Insert sheet explosive charge snugly between stud and jamb.
(c) Place electric blasting cap in charge, and fasten one leg wire to top bracket.
(d) Bore pull wire hole at proper spot inside jamb.
(e) Cut other leg wire long enough to twist on an insulated loop on one end and fit over pull wire hole. Loop should be about ½ inch in diameter.
(f) Twist on uninsulated loop on one end of leg wire and secure to lower bracket so that loop fits over pull wire hole. Fasten wire to jamb.
(g) Anchor one end of insulated pull wire at proper spot on door, and thread free end through pull wire hole and loop fastened to jamb.
(h) Close door. Fasten free end of pull wire to other loop to hold it snugly against stud.
(i) Check circuit with galvonometer first, then
(j) Install batteries between brackets.
(k) Conceal boobytrap.



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43. **Structural Framework**

a. In a building charges should be placed where detonation will seriously impair its structural strength, such as walls, chimneys, beams, and columns. Charges and firing devices must be carefully concealed to avoid detection.

b. In boobytrapping load-bearing walls, several charges should be laid to detonate simultaneously near the base. Chimneys and fireplaces are difficult to boobytrap for charges placed there are readily detected These should detonate from intense heat

c. Beams and columns when they collapse cause much more damage than walls because they bear much more weight.

(1) In wooden beams, holes for concealed explosives should be bored close enough together for sympathetic detonation. An M1 delay firing device and detonator placed in a hole

within the bulk explosive charge should suffice. Buildings of masonry and steel construction may also be booby-trapped with delay charges. The difficulty of the job depends often on the interior finish, type of decoration, heating ducts, air conditioning, and type of floors.

(2) A column may be destroyed by a charge buried below ground level at its base. Although heavy delay charges like these are often considered mines, they are shown here because they may be found in booby trap locations.

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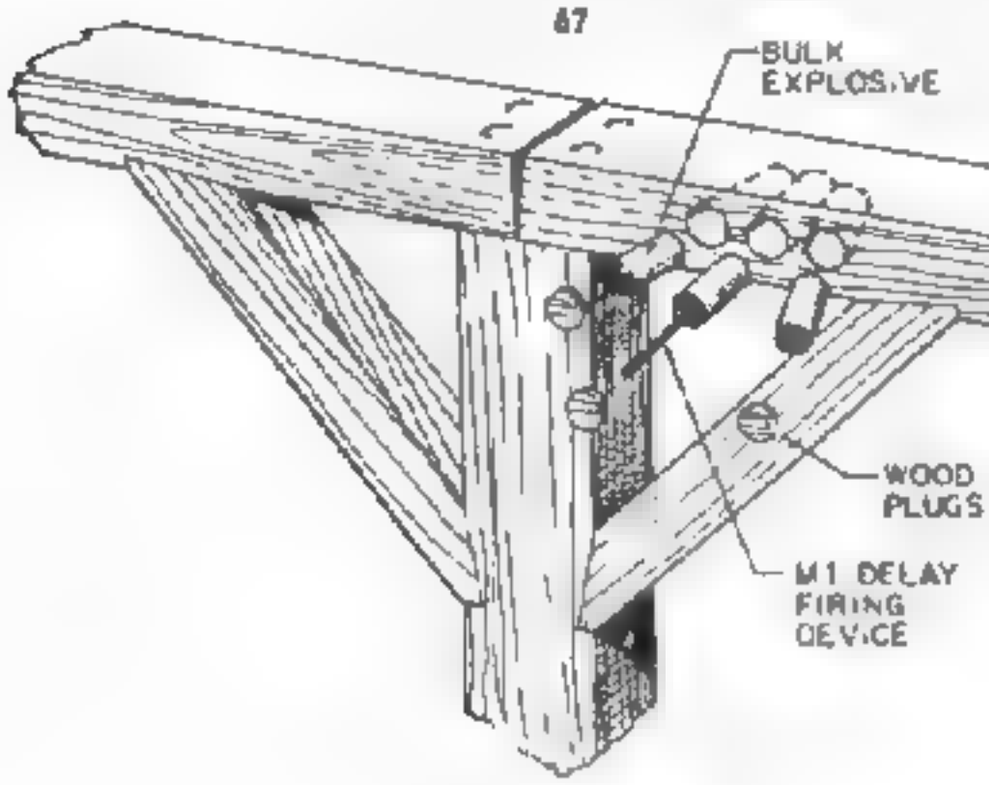

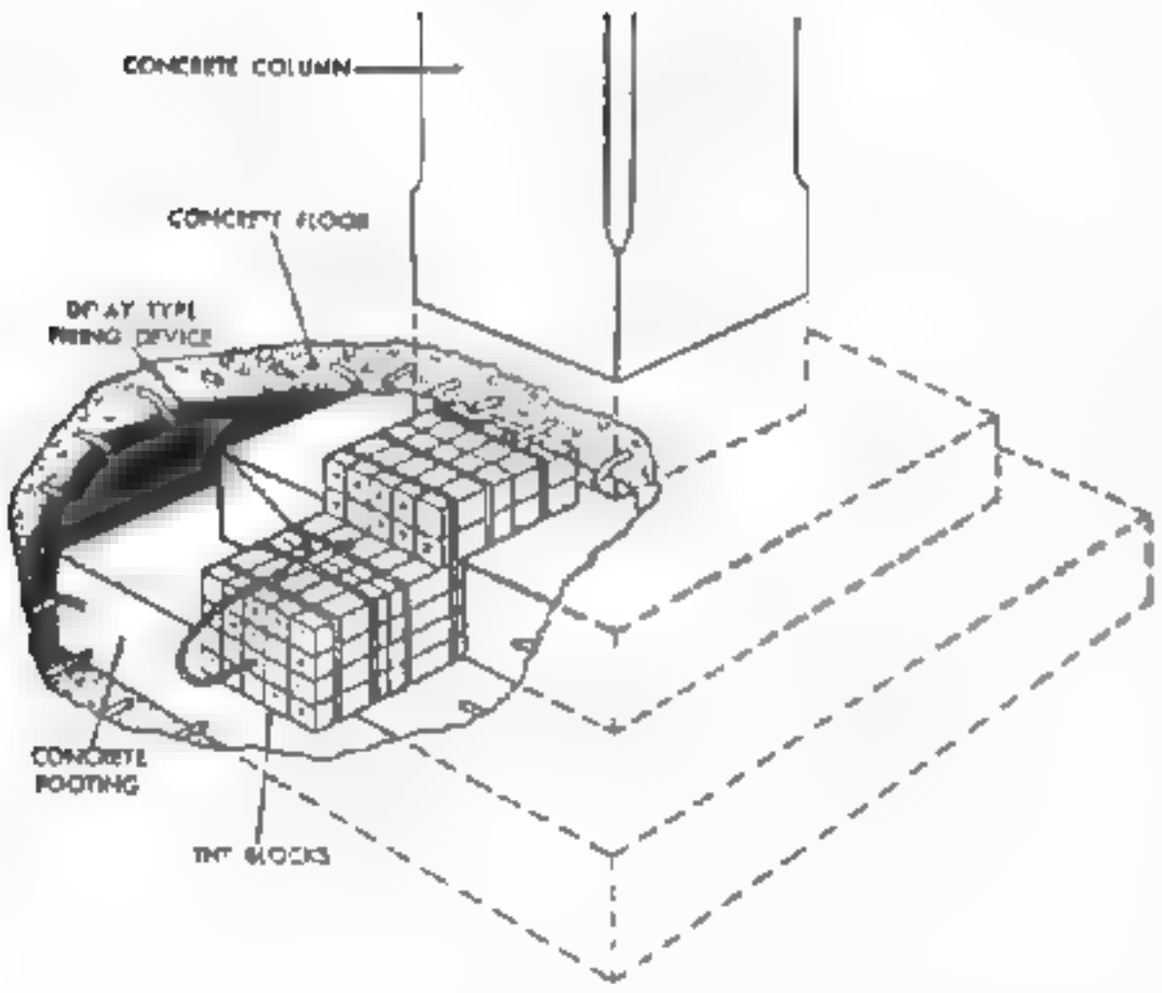

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d. Loose floor boards sometimes are excellent objects for booby trapping. The rigging must escape detection, however; otherwise, it will be ineffective. This rigging might be harder to detect if the support underneath is chiseled out to let the floorboard sink about ¼ inch when tramped on.

e. A double delay chain detonating booby trap should be very effective if timed right and skillfully laid. *First*, is the explosive of a minor charge laid in an upper story damaging the building only slightly. *Then*, after a curious crowd has gathered, a second heavy charge or series of charges go off, seriously damaging or destroying the building and killing or wounding many onlookers.

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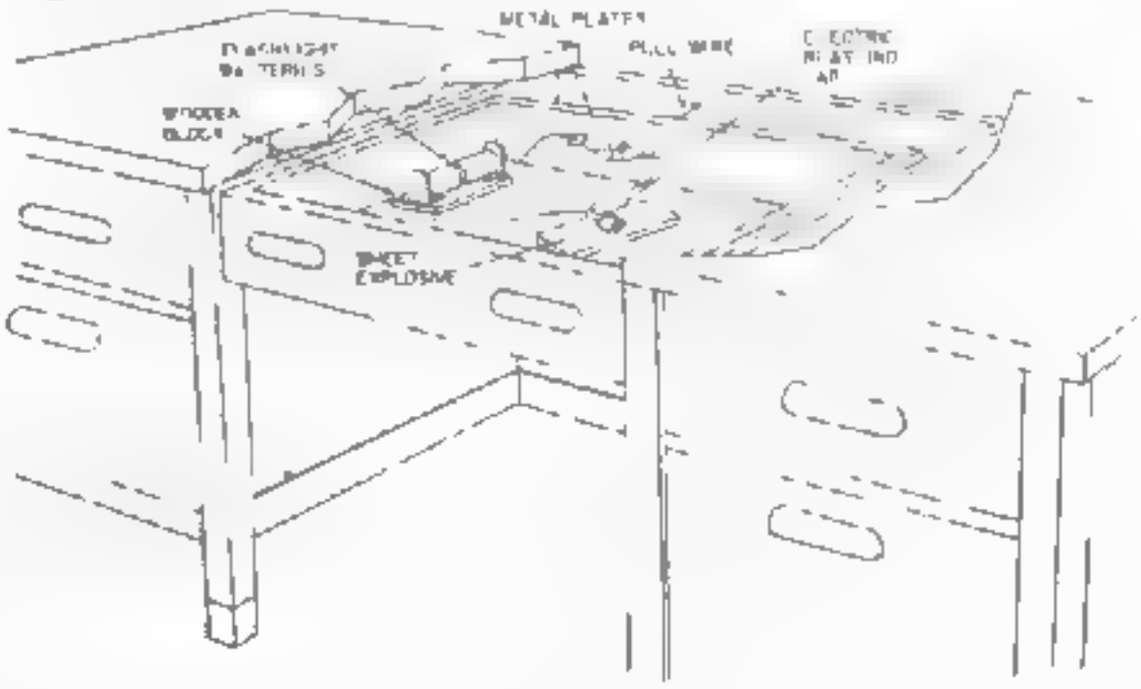
44 Interior Furnishings

Vacated buildings provide much opportunity for booby trapping. Hurriedly departing occupants usually leave behind such odds and ends as desks, filing cases, cooking utensils, table items, rugs, lamps, and furniture. Electric light and power fixtures are also exploitable.

a. Desk. Because of its construction a desk is easily booby trapped. If carefully placed the rigging may be nondetectable and if properly constructed, cannot be neutralized. Electric firing systems are the most suitable for this purpose. Sheet explosive is much better than other types, because its adhesive surface holds it firmly in place. Check the circuit with a galvonometer *before* installing the batteries.

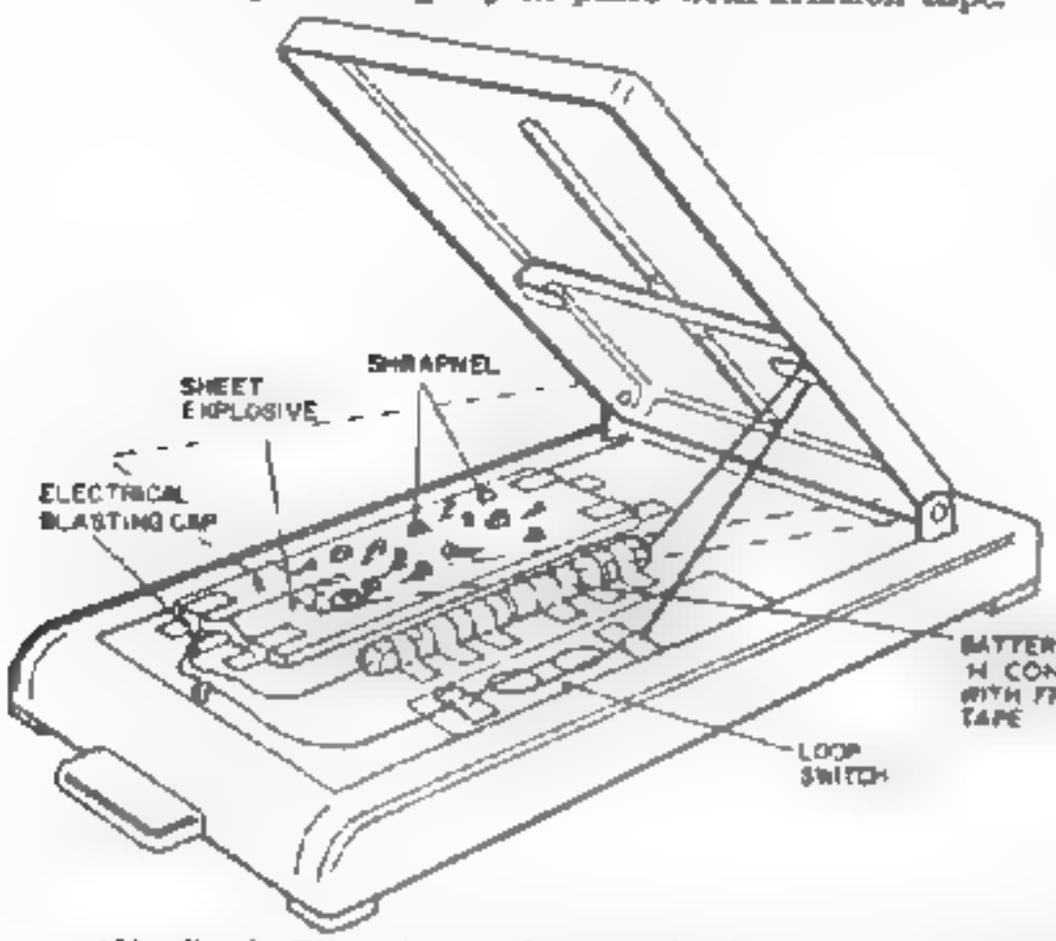


b. Office Equipment. Many items used in offices have boobytrap potential.

(1) *Telephone hat finder.*
- (a) Remove contents from finder.
- (b) Assemble sheet explosive, shrapnel and blasting cap.
- (c) Remove insulation from ends of wires and twist to form loop switch.

(d) Place boobytrap in finder so that the raising of the lid draws the loops together.
(e) Insulate inside of case from contact with loops with friction tape.
(f) Check circuit with galvanometer *first*, then install batteries.

Note. Batteries may be connected to legwires by wrapping them tightly in place with friction tape.



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(2) *Card File.* A wooden card file can be boobytrapped effectively by the use of a mousetrap rigged as a trigger, a standard base with blasting cap attached, a support block fastened inside to hold the firing assembly at the proper level for operation, and a trigger block to hold the trigger in armed position

(a) Rig wire trigger of mousetrap with screw and metal strip.
(b) Locate support block on strips at proper level to fix trigger in trigger block.
(c) Bore hole in support block at proper place to admit standard base and blasting cap so that sheet metal screw will strike percussion cap.
(d) Insert explosive, then support block with mousetrap, standard base, and blasting cap in position.
(e) Raise trigger and close lid so that trigger is fixed in firing position.

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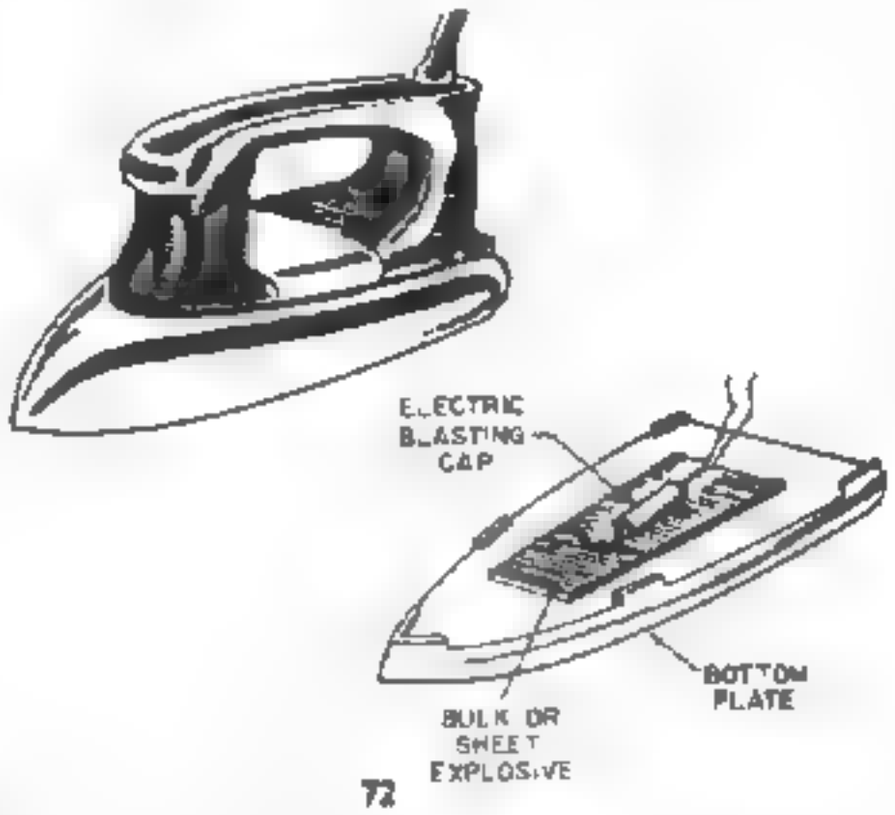
e. Electric Iron.

(1) Remove bottom plate.
(2) Insert bulk explosive and electric blasting cap.
(3) Attach shortened leg wires to power inlet.



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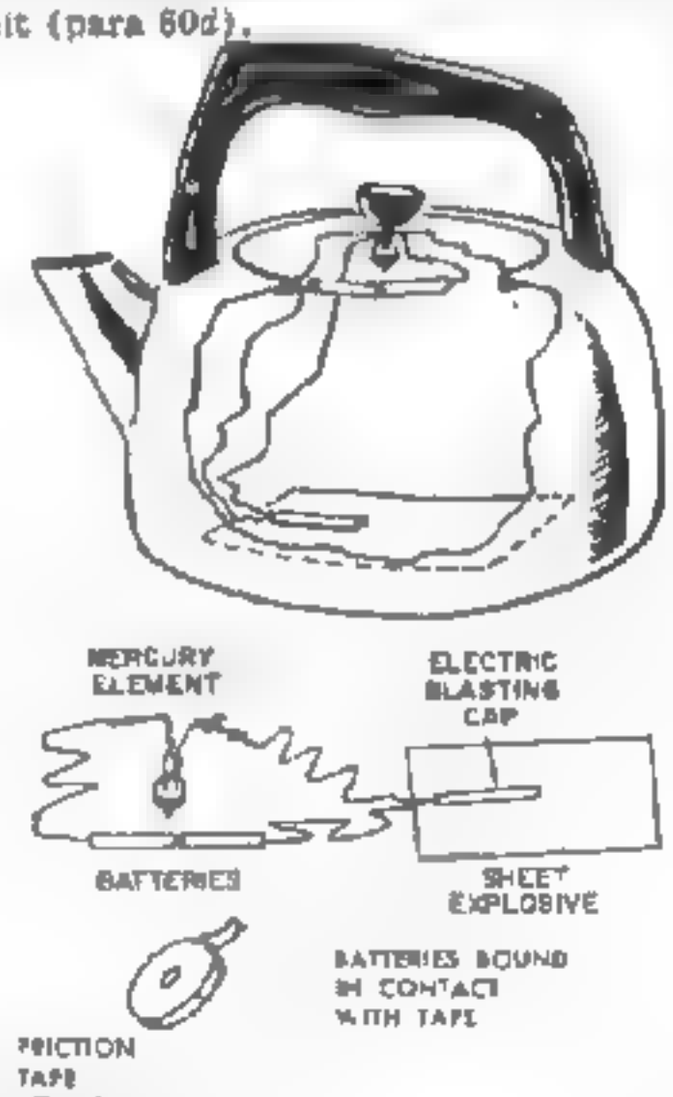
d. Teakettle.

(1) Assemble sheet explosive, electric blasting cap and mercury element in teakettle.
(2) Check circuit with galvanometer first, then install batteries.

Note. Batteries may be bound tightly in circuit with friction tape. For safety and ease of assembly, use a wrist watch delay in circuit (para 60*d*).



e. Pressure Cooker

(1) *Antidisturbance circuit.*

(a) Assemble sheet explosive, mercury element, and electric blasting cap in cooker.
(b) Check circuit with galvanometer *first*, then install batteries.

Note. Batteries may be bound tightly in circuit with friction tape. For safety and ease of assembly, use a wrist watch delay in circuit (para 60*d*).

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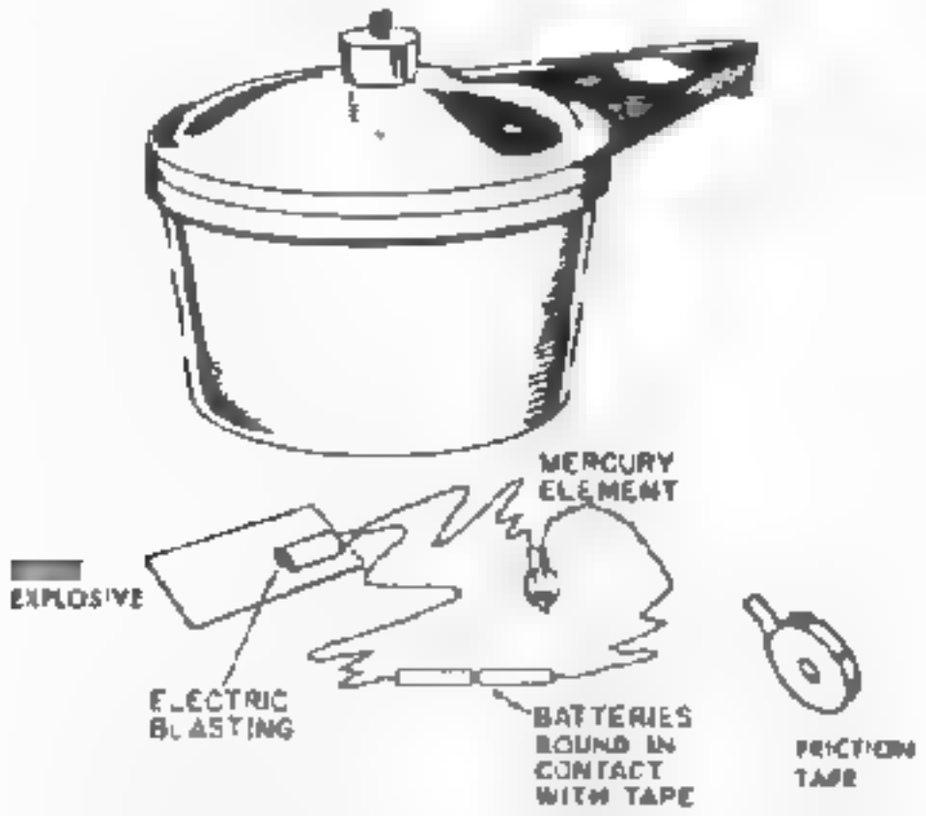
(2) *Loop switch.*

(1) Assemble sheet explosive and electric blasting cap.
(2) Cut leg wires to proper length. Remove insulation

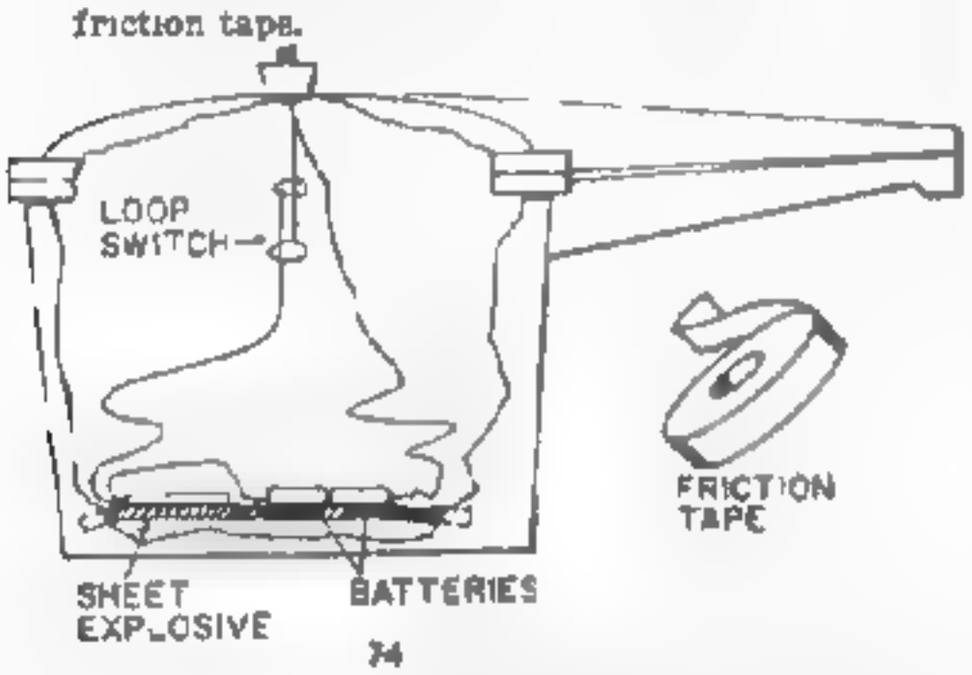


from ends and twist to form loop switch.

(3) *Check circuit with galvonometer.*

(4) Fasten one leg wire (insulated) to lid to serve as pull wire.

(5) Secure batteries in circuit by wrapping tightly with friction tape.



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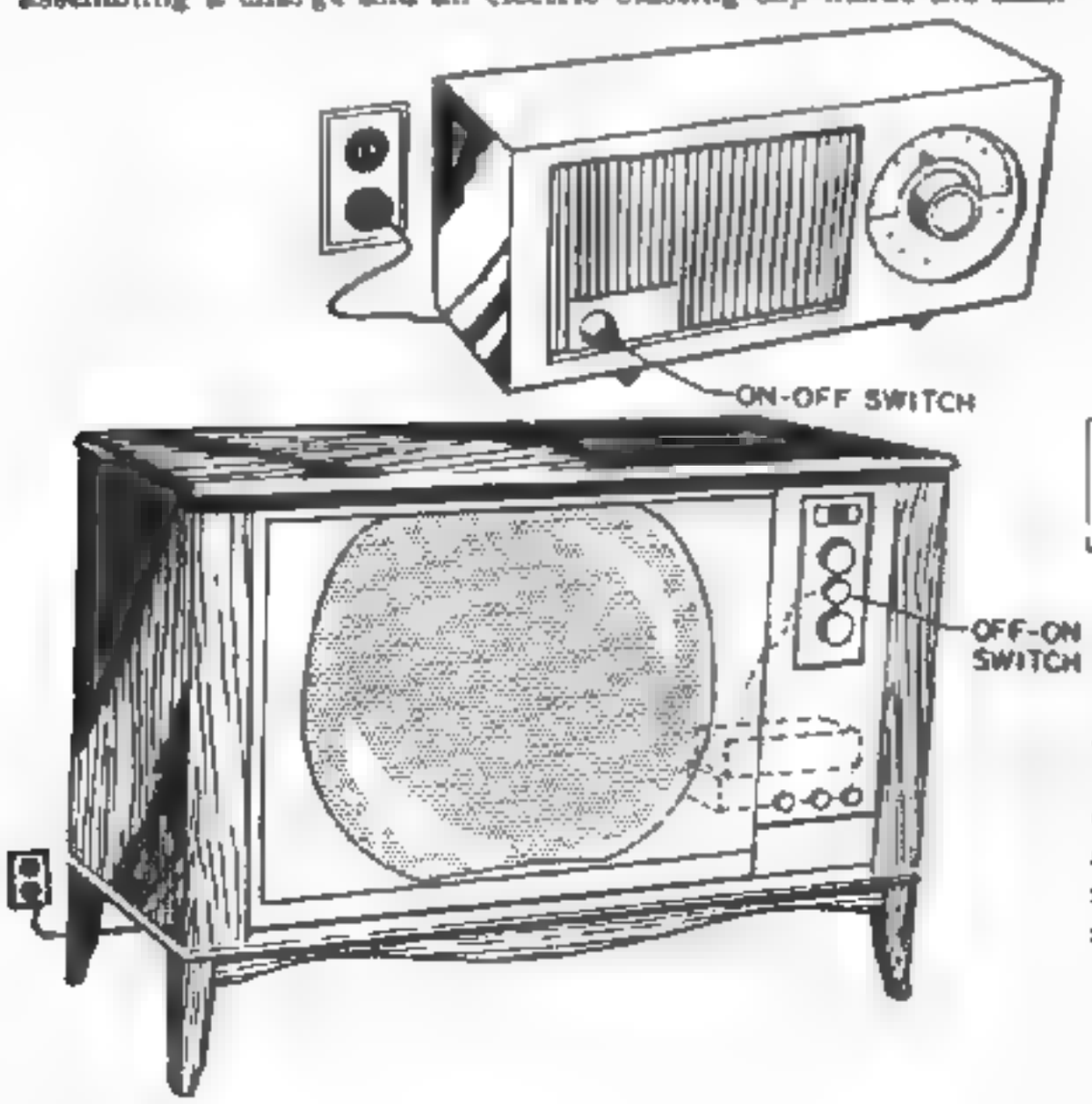
f. Radio and Television Sets. Both sets may be boobytraped by assembling a charge and an electric blasting cap inside the case.



The leg wires are connected in the circuit for detonation at turning of off-on switch.

Extreme care is required in connecting leg wires to prevent premature explosion.

g. Bed. Two methods may be used -a charge, nonelectric blasting cap, and pull firing device or a charge. batteries, electric blasting cap, and a mercury switch element.

(1) *Nonelectric rigging.*

(a) Assemble pull wire, M1 pull firing device, blasting cap, and sheet explosive charge

(b) Anchor pull wire so that a person sitting or lying on bed will initiate firing device.

(c) Conceal boobytrap

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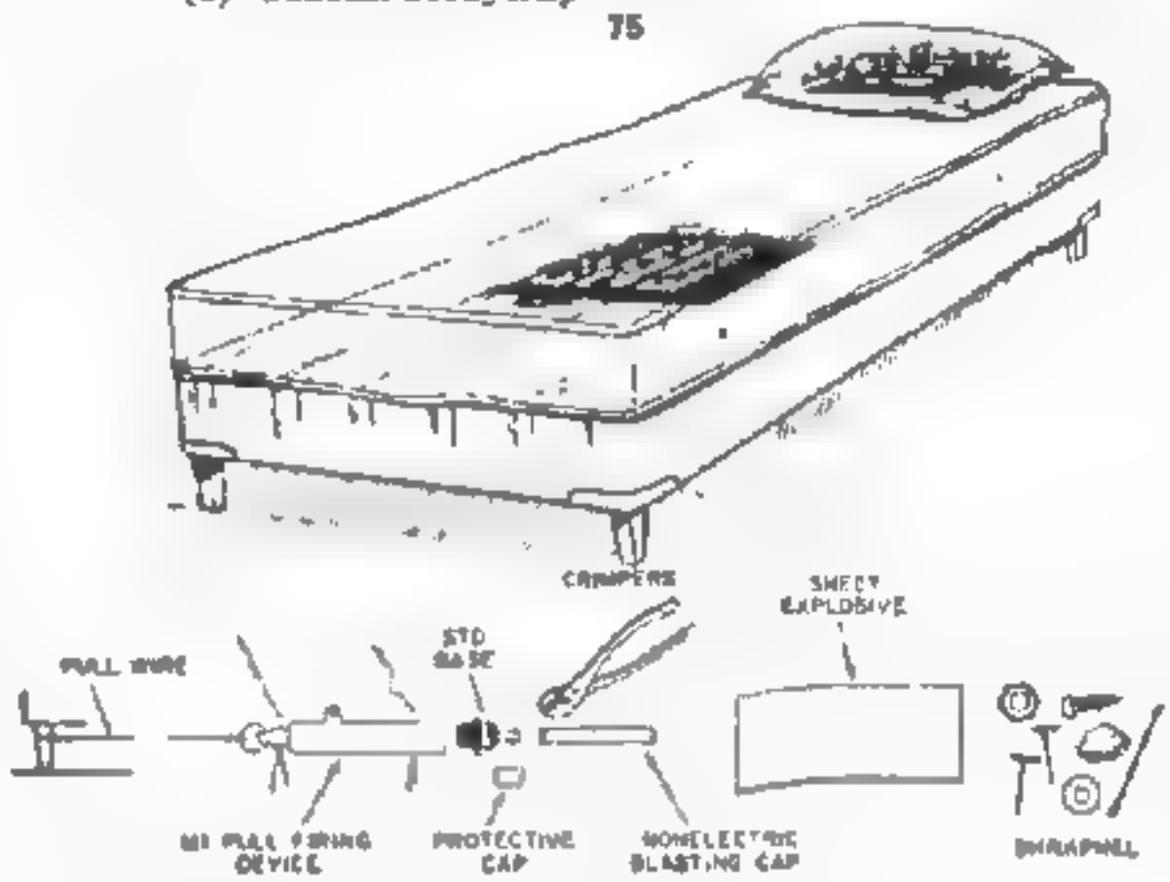


(2) *Electric rigging.*

(a) Assemble sheet explosive charge, electric blasting cap, and mercury element.

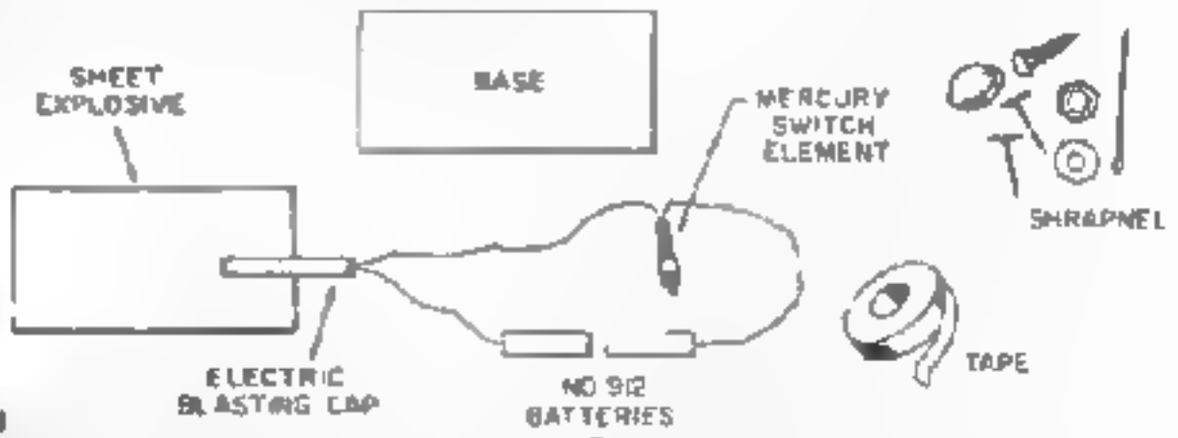
(b) Check circuit with galvanometer.

(c) Place boobytrap on bed to initiate when its level position is disturbed.

(d) Install batteries in circuit by wrapping tightly with friction tape.

(e) Conceal boobytrap.

Note. For safety and ease of assembly, use a wrist watch delay in circuit (para 60*d*)



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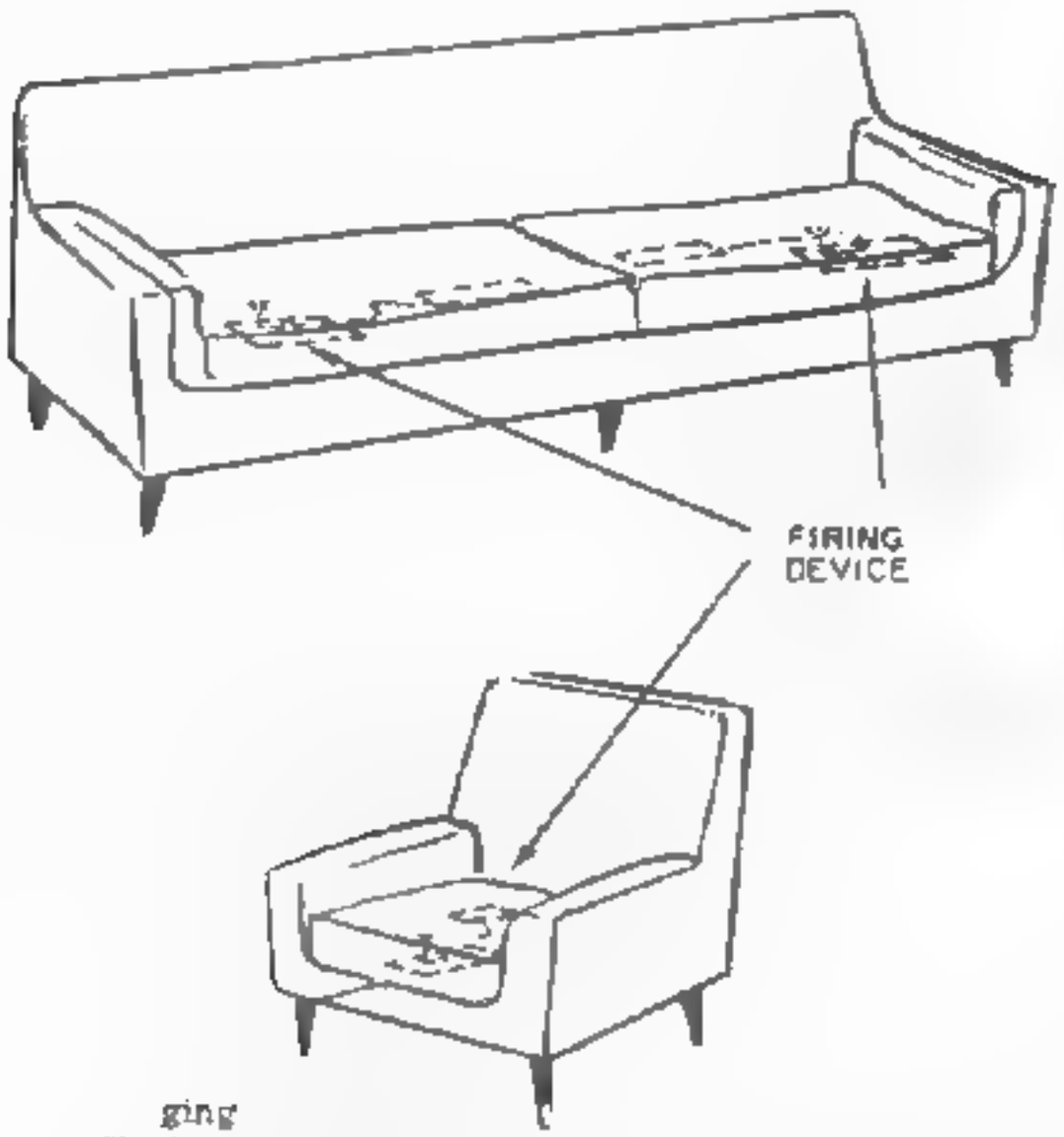
h. Chairs and Sofas. These may be boobytrapped nonelectrically and electrically as in *f* above. For nonelectric rigging the M1A1 pressure firing device, nonelectric blasting cap and sheet explosive charge are probably the most suitable. The sofa because of its size should have more than one rigging. If the electrical method is used *the circuit should be tested with the galvanometer before the batteries are installed.*

i. Book. A book with an attractive cover is sure to invite examination.

(1) Cut hole in book large enough to accommodate the rig-



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(2) Assemble sheet explosive, electric blasting cap, mercury element, and shrapnel.

(3) *Test circuit with galvanometer first*, then

(4) Secure batteries in circuit by wrapping tightly with friction tape.

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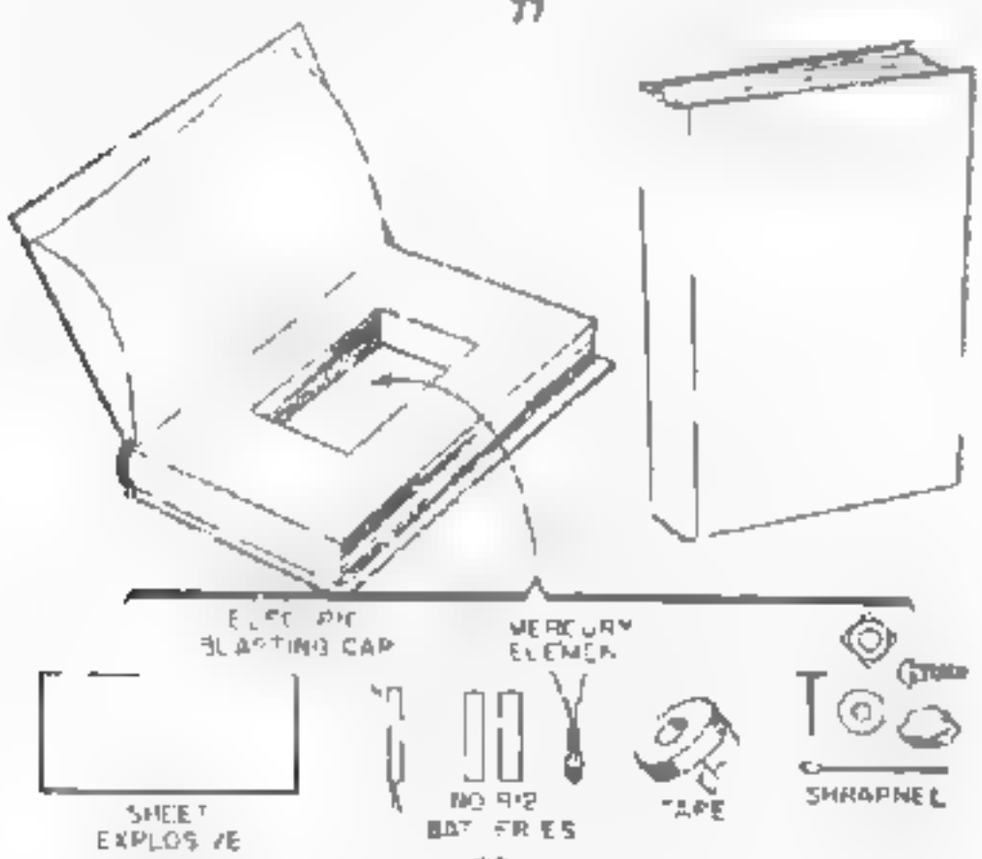

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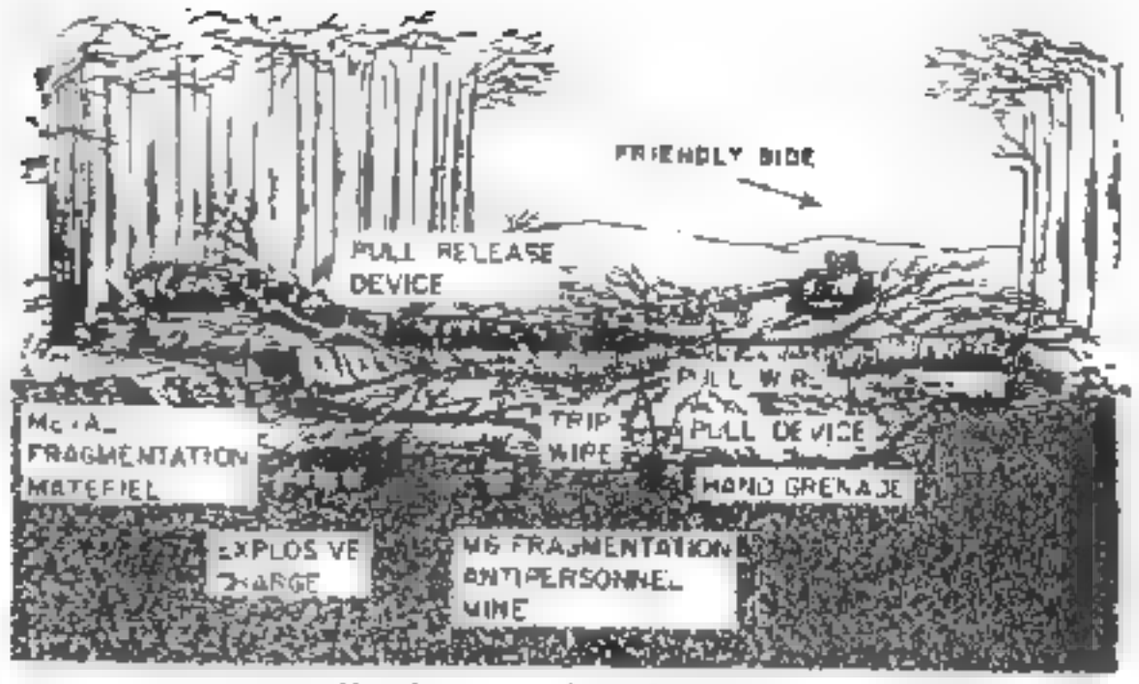
Section III. TERRAIN

45 Highways, Trails, and Paths

Boobytraps used along roads are a great help in slowing down enemy traffic, especially if they are laid in and around other obstructions. Those placed on paths and trails are excellent against raiding parties that must operate under cover of darkness.

46. Locations

Boobytraps in roadway obstructions should be concealed on the enemy side. If the obstruction is heavy, requiring force to remove it, boobytraps concealed underneath will increase its effectiveness. Fragmentation charges are very destructive against personnel. These include hand grenades, bounding antipersonnel mines with their own special fuzes actuated by pressure or trip wire; ordinary explosive charges covered with pieces of scrap metal, nails, gravel, lengths of wire, nuts and bolts; and the like. The latter may be actuated by any of the standard firing devices—by pressure,



pressure-release, pull-release, and pull.

a. The jet of the M2A3 shaped charge from the roadside directed into a moving vehicle is very destructive.

(1) Assemble an M3 pull-release firing device and detonator, length of detonating cord, priming adapter, and nonelectric blasting cap.

(2) Drive anchor stake in berm at side of road and attach pull wire. Drive stake or lay log, stone, or other object on other side to support pull wire at proper height off ground.

(3) Attach firing device assembly to stake at proper position.

(4) Fix shaped charge in position to direct explosive jet into vehicle when front wheel shut trip wire.

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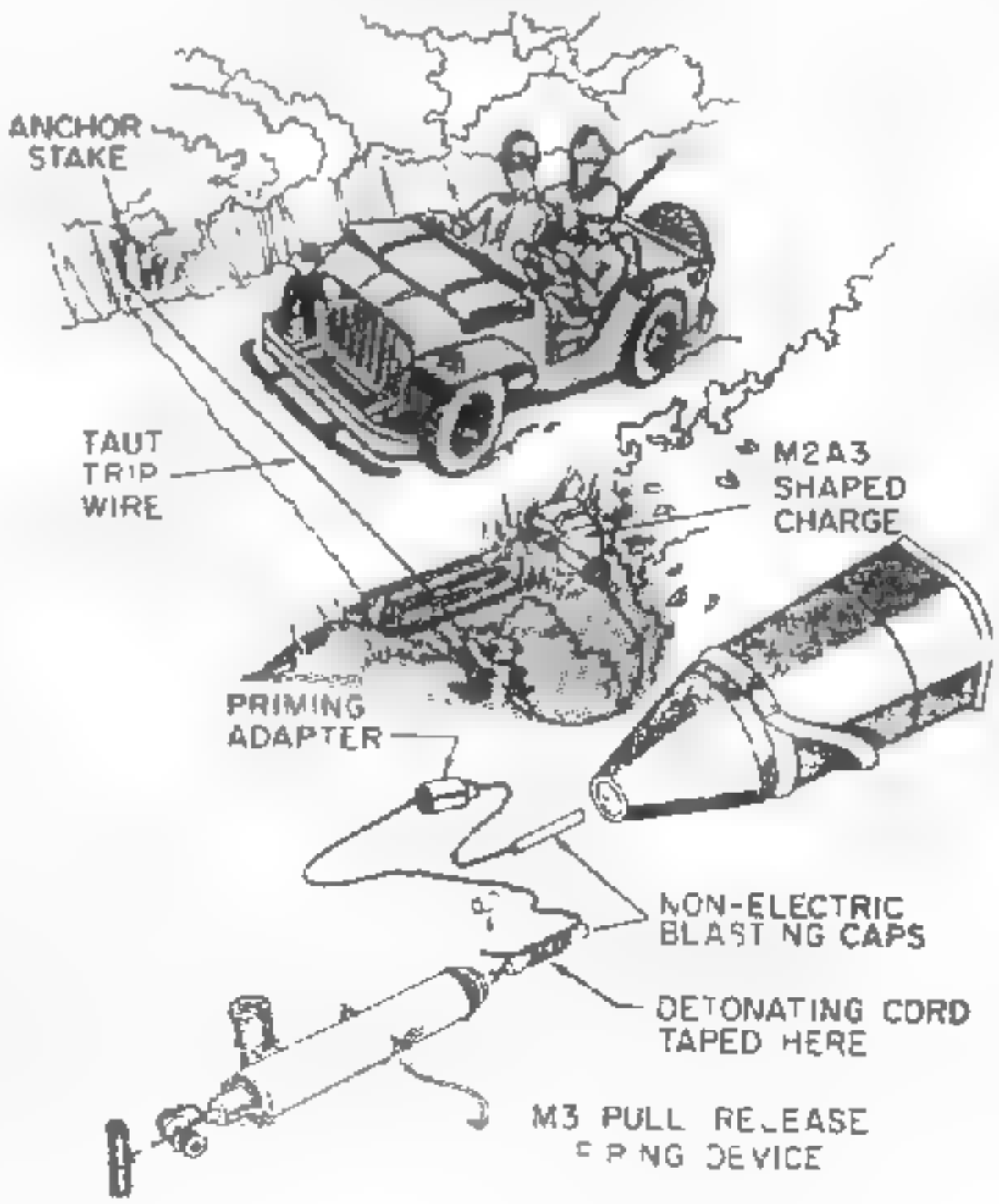
(5) Attach free end of pull wire in hole in winch and draw taut.

(6) Screw priming adapter and nonelectric blasting cap in threaded cap well.

(7) Conceal boobytrap.

(8) Arm firing device.

Note: Cone may be filled with fragments.

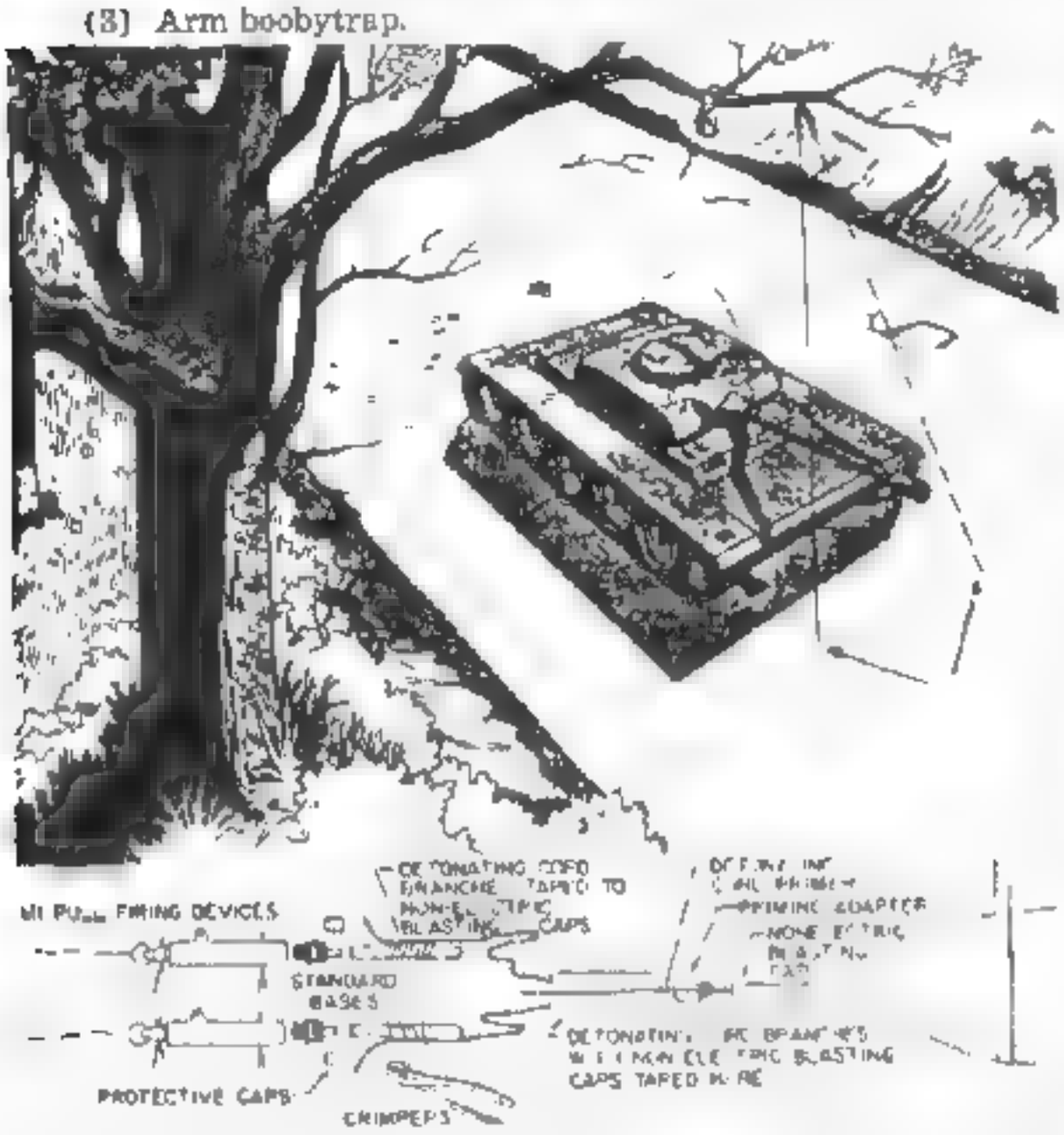


b. An M3 shaped charge boobytrap placed overhead in a tree in a wooded area will destroy both tank and crew if located properly. Trip wire being very thin and camouflage-colored, is not easily detected by a driver.

(1) Assemble two firing devices (only one may be necessary) with detonators and lengths of detonating cord and a detonating cord primer

(2) Attach firing assemblies and M3 shaped charge in position in tree, so that when the vehicle contacts the trip wires the explosive jet will penetrate the crew compartment.

(3) Arm boobytrap.



c. Boobytraps laid in and along a narrow path may prove a delaying or frustrating obstacles to foot troops. These may be improvised shrapnel charges with a pressure-release firing device concealed under a stone piece of wood, or other object, or with a pull or pull-release firing device and a trip wire. The latter would be very effective against patrols

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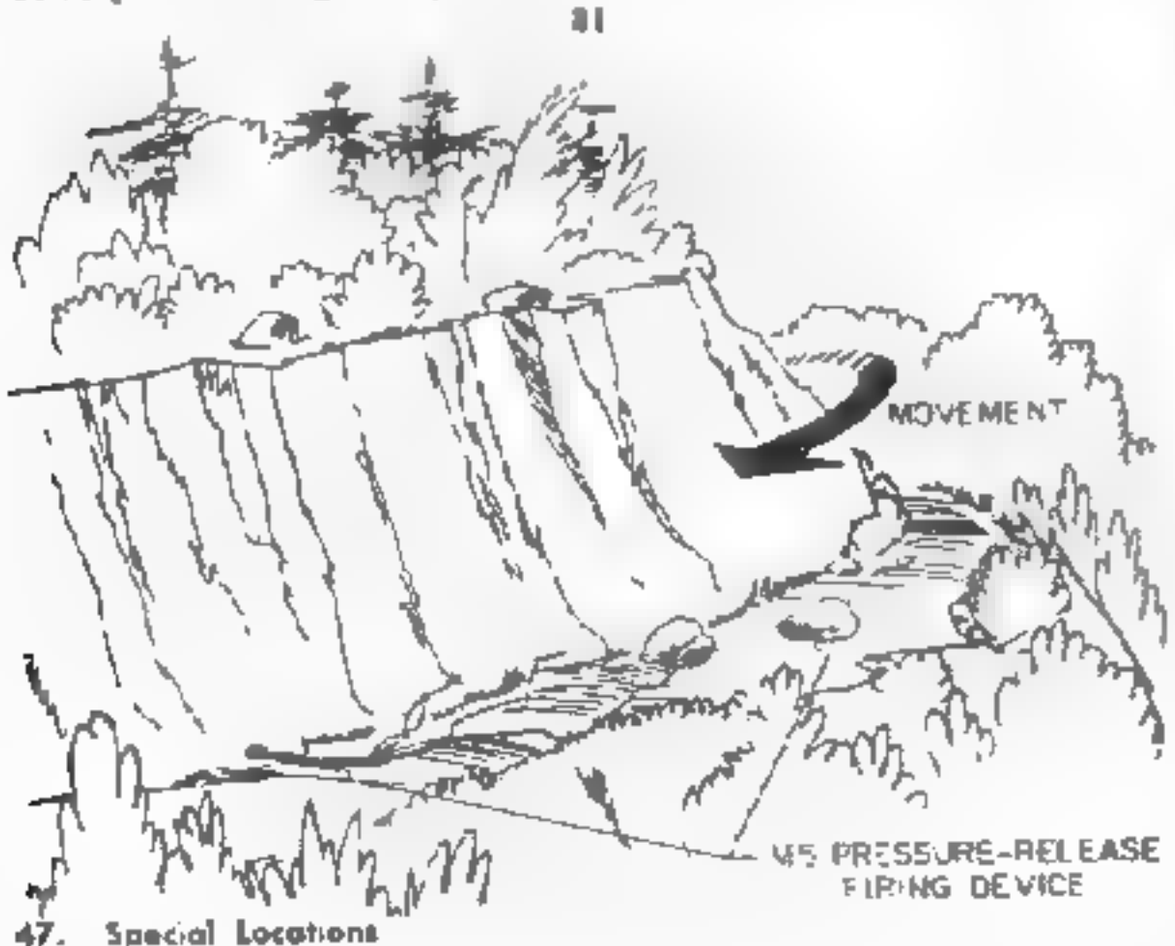
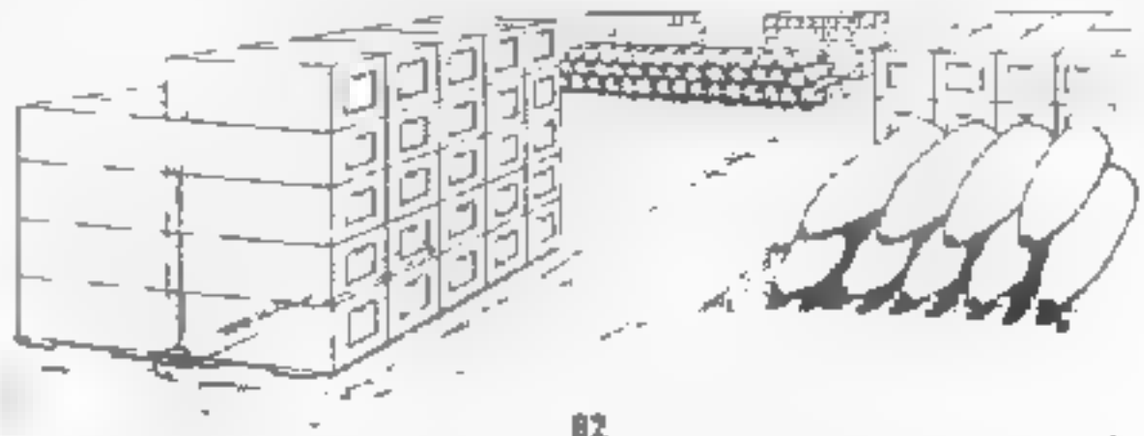


47. Special Locations

a. Abandoned serviceable or repairable items are frequently boobytrapped if time and equipment are available. Even unserviceable items may be rigged against scavangers who may search through the wreckage for useful things.

b. Abandoned ammunition should be exploited to the maximum. Chain detonations of connected mines or sections of bangalore torpedo are particularly effective



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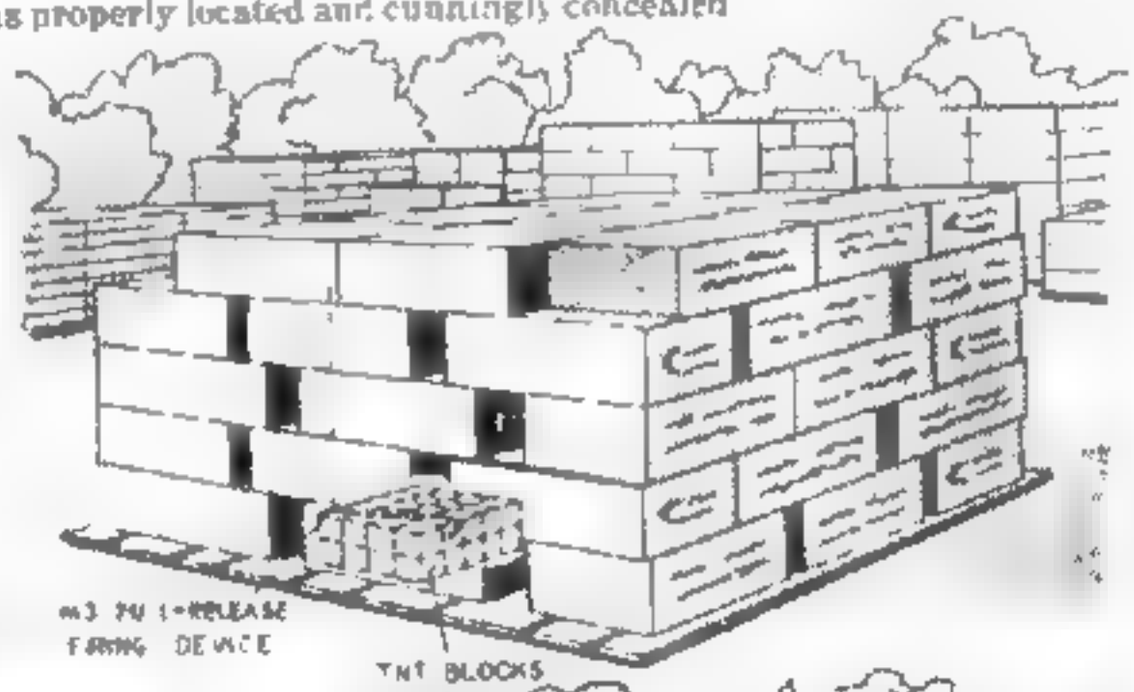
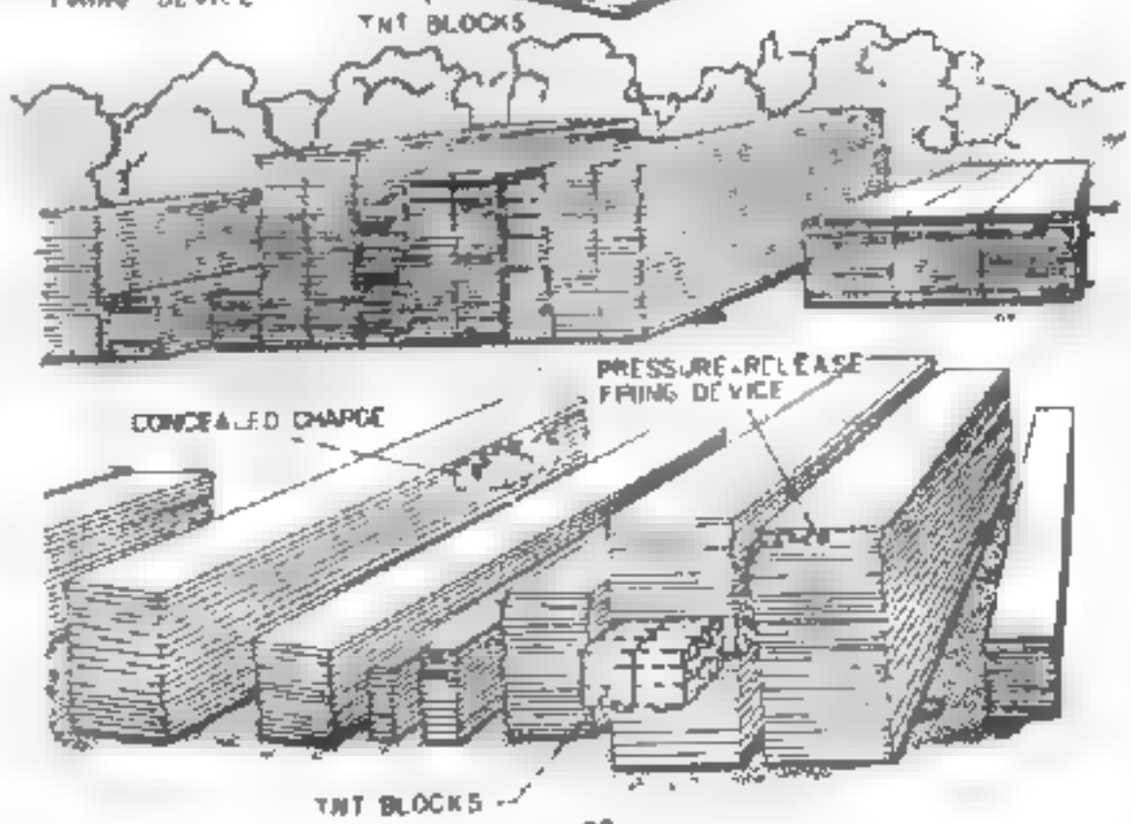
c. Boobytraps are applicable to storage areas where materials cannot be removed or destroyed. Several charges strategically laid will prove very rewarding. A lumber pile provides excellent concealment for an explosive rigging Sheet explosive may be used in many places where TNT is impractical, because of its size and shape. Here again chain detonations of explosive blocks and bangalore torpedos will do extensive damage, if the firing mechanism is properly located and cunningly concealed





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48. Abandoned Vehicles

a. Truck Wheel

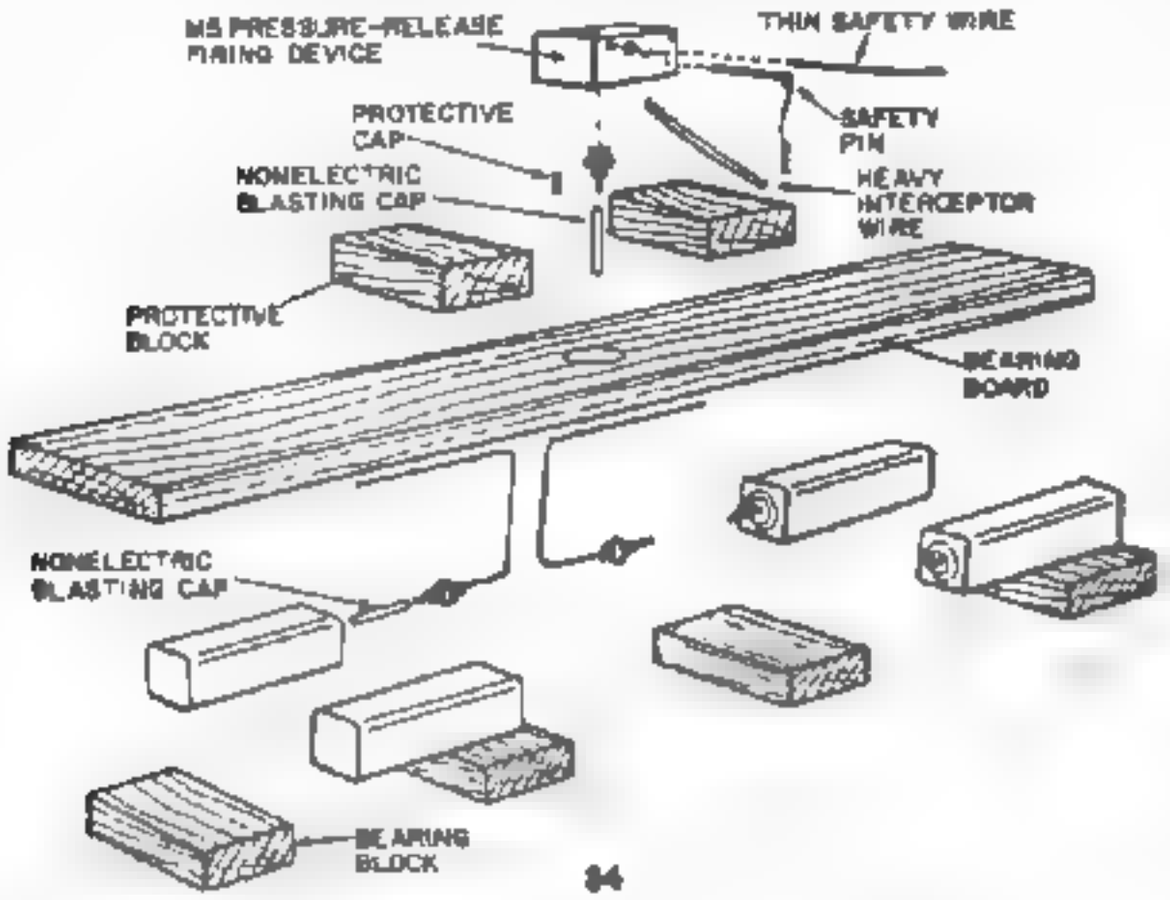
(1) Insert length of heavy wire in interceptor hole in firing device.

(2) Remove safety pin and replace with length of thin wire. Bend both wires slightly to prevent falling out.

(3) Assemble standard base, nonelectric blasting cap, and firing device

(4) Assemble two 2-block explosive charges nonelectric blasting caps, priming adapters, and length of detonating cord.

(5) In hole prepared under truck wheel, assemble bearing blocks (take weight off explosive charge), charges, bearing board, protective blocks (take weight off firing device), and firing device.
(6) Arm firing device.
(7) Cover boobytrap, and camouflage.



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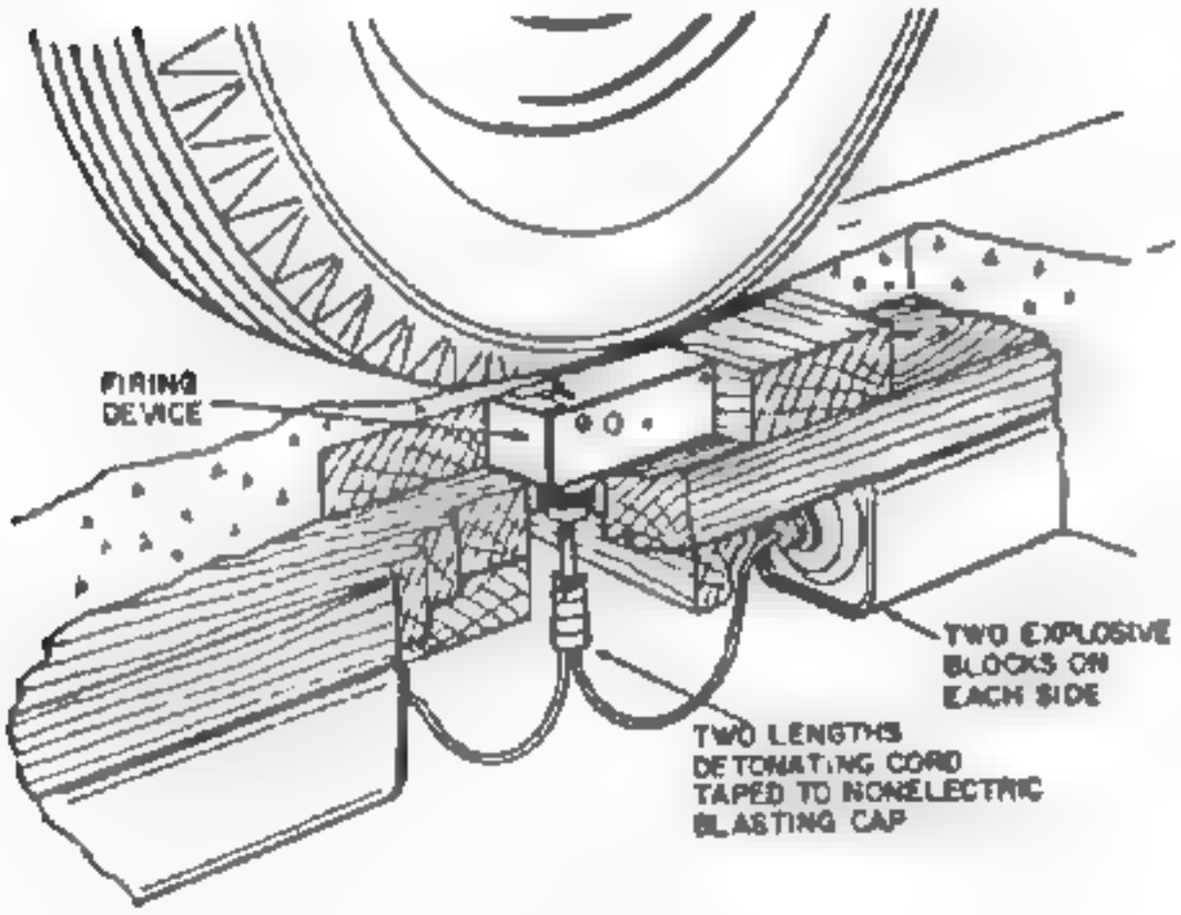

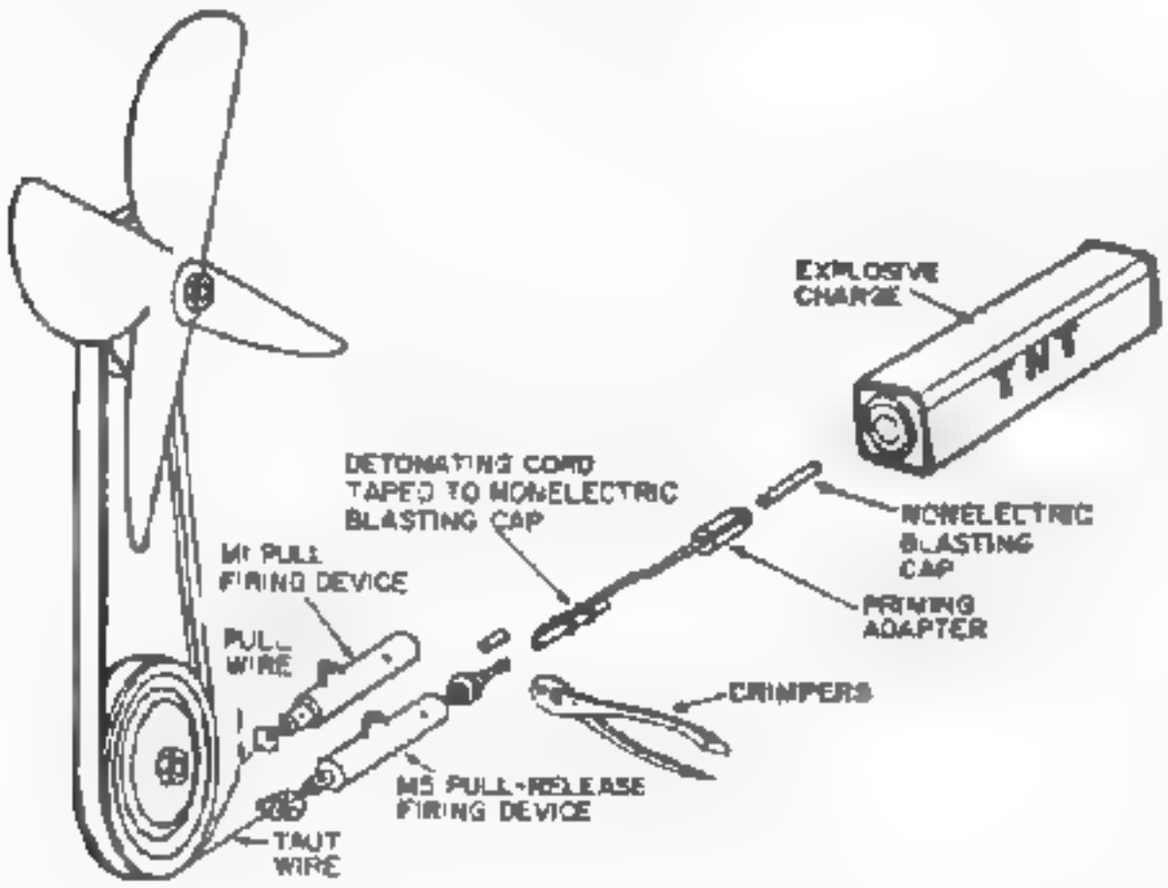

b. *Motor.* The fan belt is an excellent anchor for a pull wire. The pull wire will be much harder to detect if anchored underneath the bottom pulley, from where it may be extended any length to the firing device and charge.

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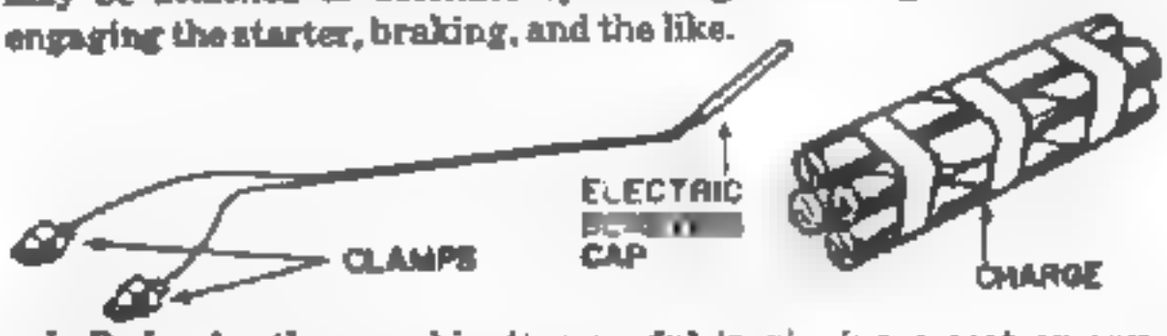
c. *Electric System.* A useful combination is a charge primed with an electric blasting cap with clamps attached to the leg wires. This may be attached to detonate by turning on the ignition switch, engaging the starter, braking, and the like.

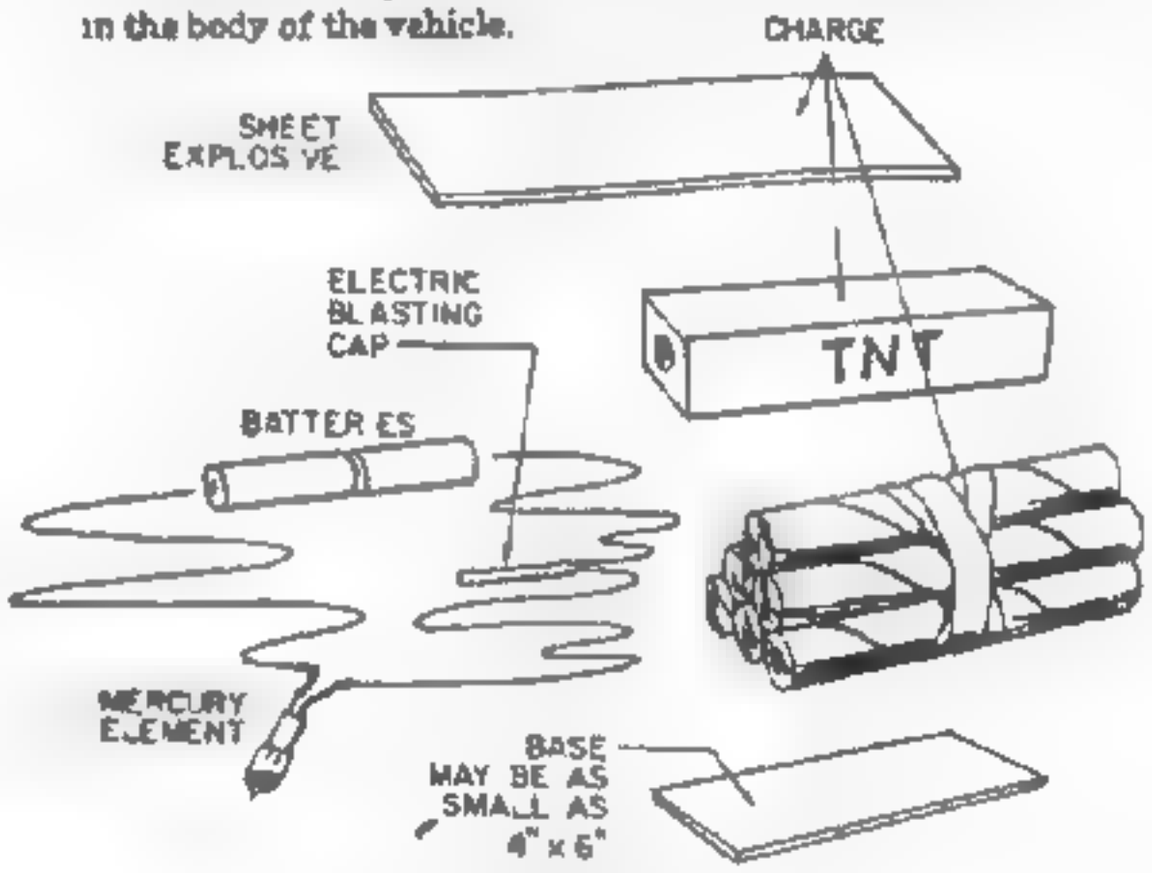


d. *Body.* Another combination useful in rigging a seat or any other part of the vehicle body is a charge detonated electrically by means of a mercury switch element.

(1) Assemble charge, electric blasting cap, and mercury element.
(2) Place boobytrap in position and check circuit with a galvanometer.
(3) Attach batteries in circuit by wrapping tightly with friction tape.

Note. Always check circuit before attaching batteries.

This rigging may be assembled in a small package for use in a seat cushion or separated for convenience for another location in the body of the vehicle.



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CHAPTER 3

MISCELLANEOUS BOOBYTRAPS

Section I. STANDARD BOOBYTRAPS

49. Tactical Use

In World War II, every major power manufactured boobytraps to use against the enemy. Most of them were charged imitations of useful objects, which maimed or killed helpless soldiers that handled them. The defect common to all standard boobytraps however, is that after the first or second explosion, all others of the same type become ineffective. A "one-shot" job hardly justifies production costs.

50. Foreign Types

a. The Soviets used more standard boobytraps in World War II than any other combatant. A weird assortment of charged imitations of items issued to German soldiers were dropped from Soviet planes. Some of these were:

(1) Cartridge boxes, apparently filled with ammunition, containing high explosives and detonators.
(2) Bandage packets containing detonators and shrapnel.

(3) Bandage cases with Red Cross insignia rigged as mines.
(4) Rubber balls, about twice the size of a fist that detonated upon impact.
(5) Silver-grey light metal boxes or flasks that exploded when the lid was raised.
(6) Cognac bottles filled with incendiary liquid.
(7) Small red flags marked with an M and attached to mines that detonated when the flag was removed.
(8) Imitation earth-grey colored frogs that detonated when pressed on.
(9) Flashlights containing high explosive which detonated when the switch was moved
(10) Mechanical pencils, watches, cigarette cases, cigarette lighters, salt cellars, and similar items that detonated when handled.

b. Knowing the German interest in books, the Soviets prepared a book boobytrap The charge inside detonated when the cover was raised.

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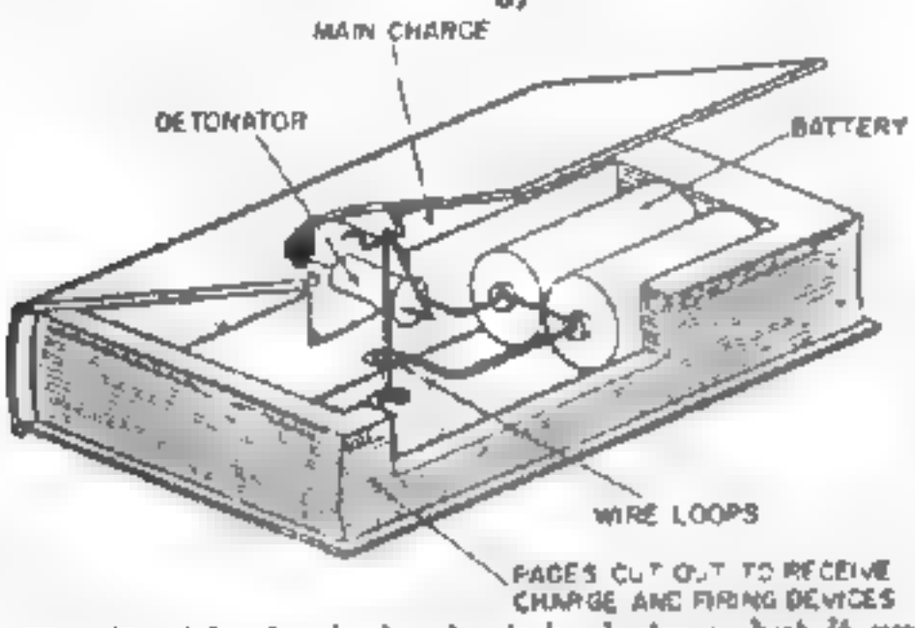
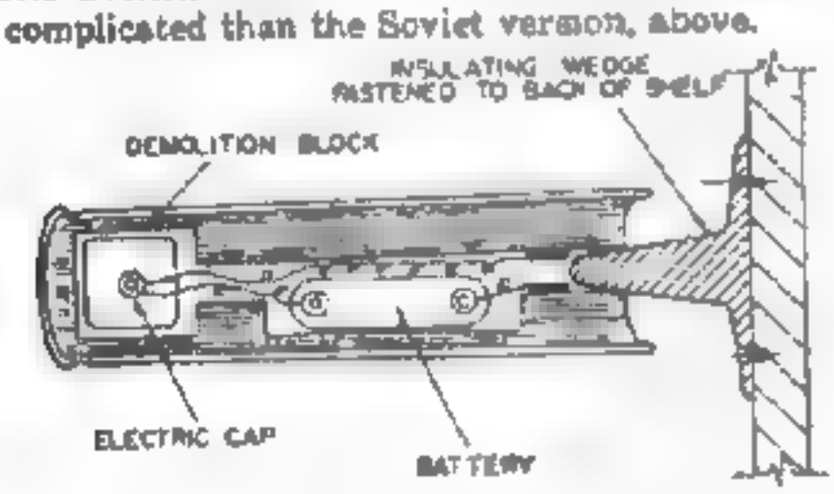
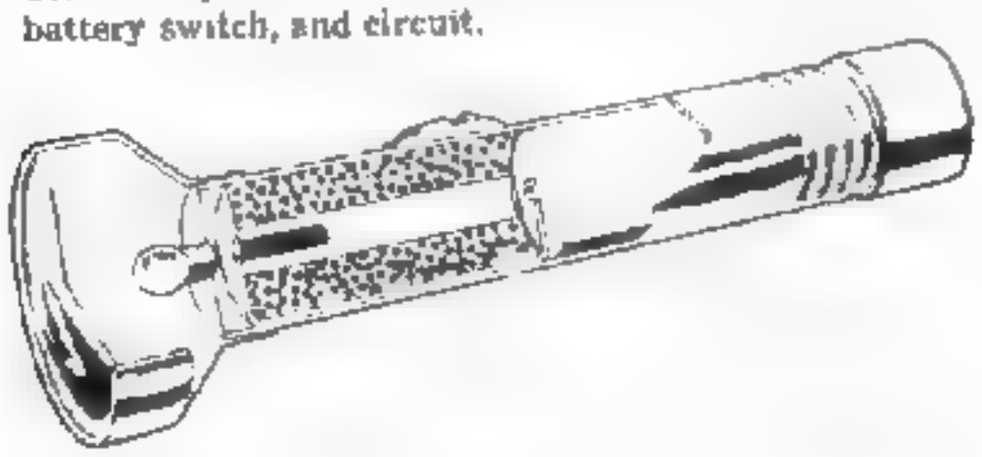


c. The British also had a book boobytrap; but it was slightly more complicated than the Soviet version, above.



d. All sorts of dirty-trick devices were used by the enemy
(1) A flashlight was rigged with a charge and an electric detonator powered and actuated by the original dry cell battery switch, and circuit.



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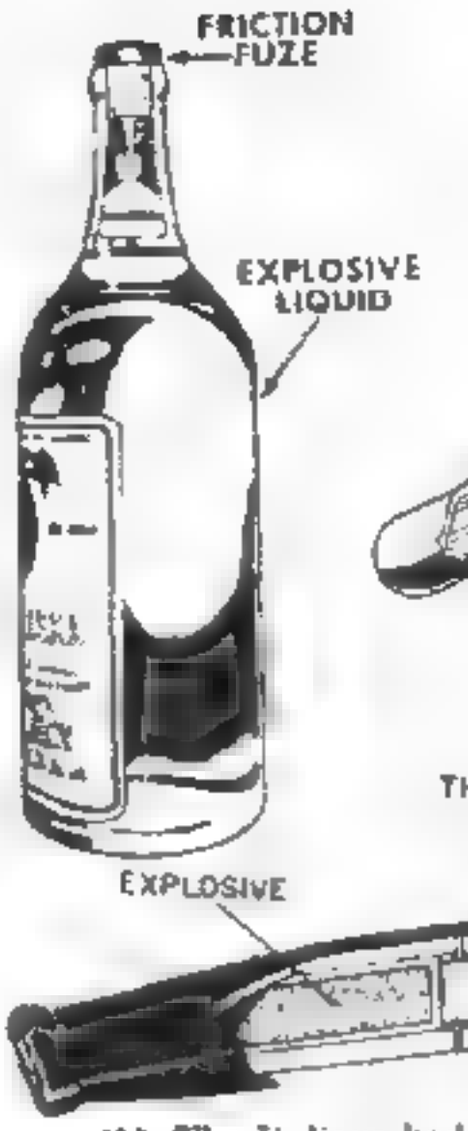
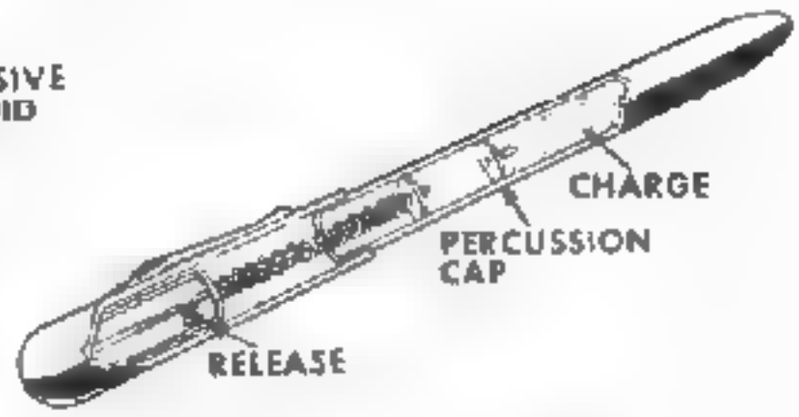
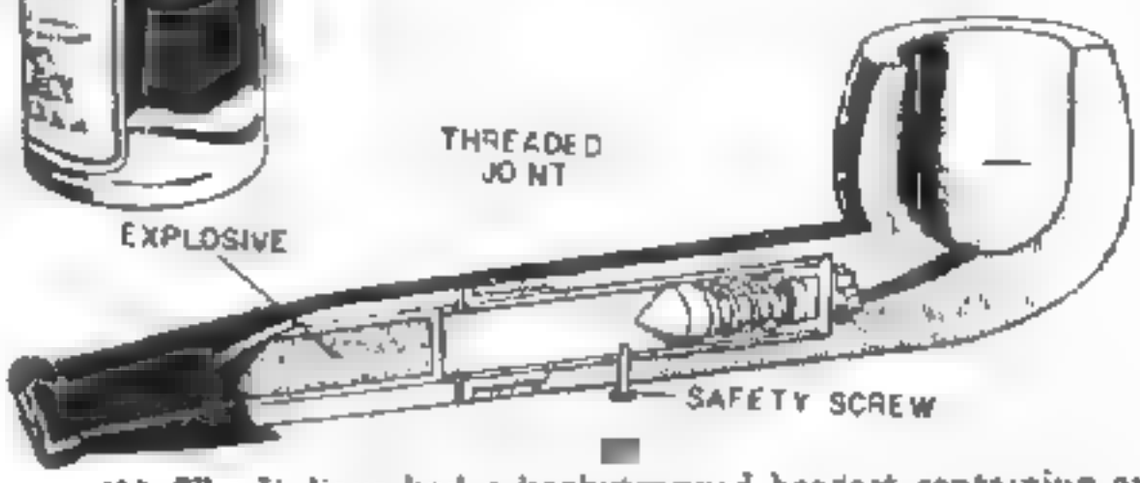
(2) Bottles designed to look like liquor bottles were filled with a liquid explosive detonated by a pull-friction fuze attached to the cork.
(3) A fountain pen, though very small was rigged with an explosive charge, a spring driven striker to fire a percussion cap, and a detonator
(4) The Japanese manufactured a pipe boobytrap with a charge, detonator, and spring-loaded striker.

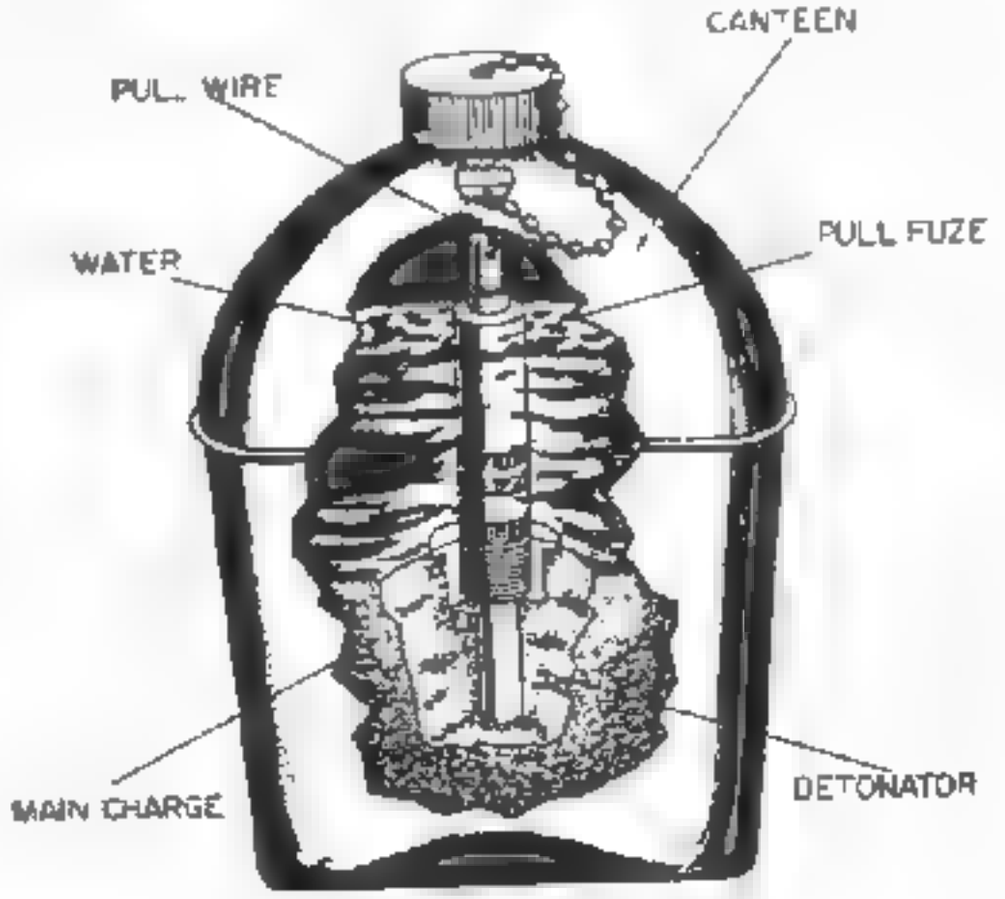






(5) The Italians had a boobytrapped headset containing an electric detonator connected to the terminals on the back. The connection of the headset into the live communication line initiated detonation.

(6) The Germans converted their own and enemy standard canteens into boobytraps. The explosive charge was detonated by a pull fuze and a pull wire connected to the cap. When partially filled with water and placed in its canvas case, it was very deceptive. The canteen boobytrap had an effective radius of 3 to 5 yards.



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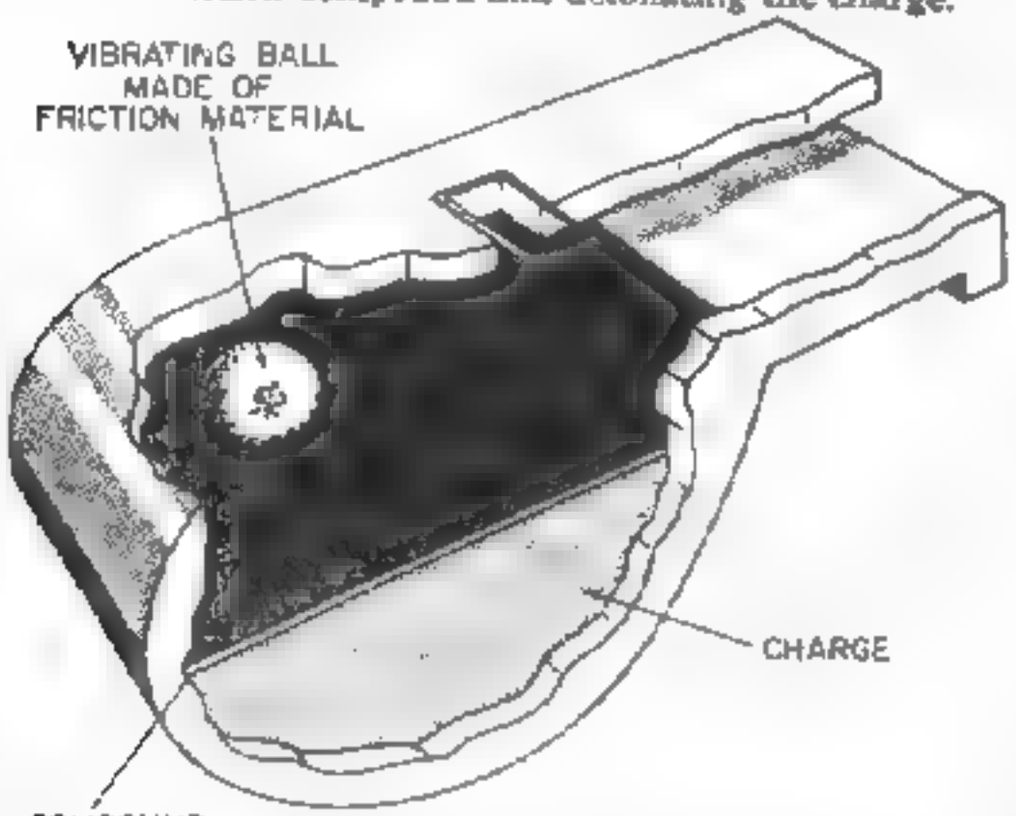
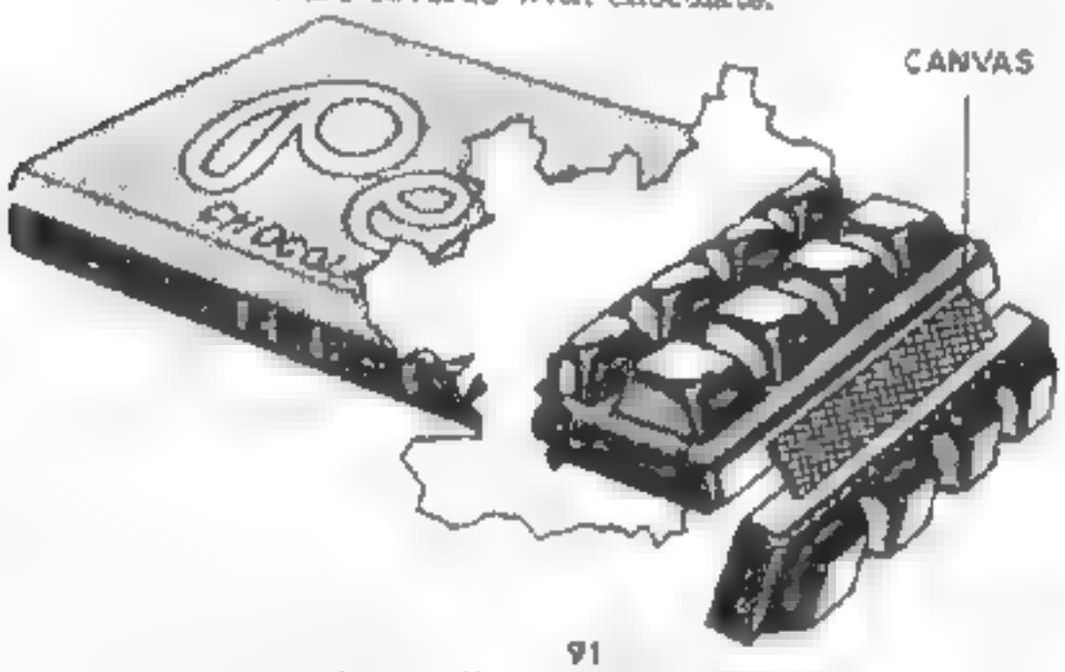
(7) Another German device was the boobytrap whistle. This consisted of a policeman's or referee's whistle with a charge and a metal ball covered with a layer of friction compound. Blowing the whistle moved the ball, igniting the friction compound and detonating the charge.



(8) The German Peters candy bar boobytrap was ingenious indeed. The explosive charge, fuze, and thin canvas pull device were covered with chocolate.



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Section II. IMPROVISATIONS

51. Ingenuity

a. Through information on military operations in World War II the U.S. soldier has been well-prepared for the dangerous mission of laying, detecting, and disarming boobytraps in conventional warfare. However, he now is virtually a novice in comparison with the cunning and ingenious present day guerrilla, who at the start was almost totally lacking in material and equipment.

b. Experience has shown that in guerrilla warfare, carried on by ill-equipped native populations, boobytrapping success depends largely on ingenuity. Explosive, a necessary element, is either improvised from commercial ingredients or captured from the enemy. Captured mines, ammunition, and other similar material are disassembled and every ounce of explosive saved.

52. Training

Every soldier should have some training in the lessons learned from the guerrillas, for many items they have improvised and the way they have used them are also applicable to conventional warfare. With little effort a soldier may be trained so that with no military equipment whatever but with ample funds, he may prepare himself to fight effectively with materials available from merchants, junk piles, and salvage.

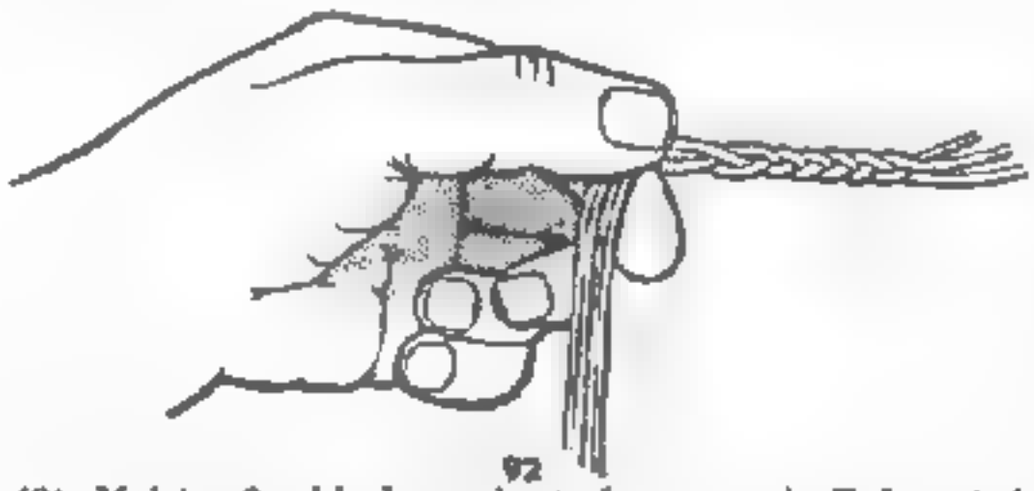
53. Application

The improvisations included in this section are gathered from numerous sources. Some may have wider application to boobytrapping than others. How the guerrilla may use them, however, is unpredictable. All are presented to stimulate initiative and arouse enthusiasm to out-do backward enemy peoples in devising and placing boobytraps and to develop a higher level of proficiency than ever before in their detection and removal.

54. Improvised Time Fuze and Explosive Caps

a. *Fast burning fuse (40 inches per minute).*

(1) Braid three lengths of cotton string together.



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(2) Moisten fine black powder to form a paste. Rub paste into twisted string with fingers and allow to dry. If a powder is not available, mix 25 parts potassium nitrate (saltpeter) in an equal amount of water and add 3 parts pulverized charcoal and 2 parts pulverized sulphur to form a paste. Rub paste into twisted string and allow to dry.

(3) Check burning rate before using.

b. *Slow burning fuse (2 inches per minute).*

(1) Wash three lengths of string or three shoelaces in hot soapy water and rinse.

(2) Dissolve 1 part potassium nitrate or potassium chlorate and 1 part granulated sugar in 2 parts hot water.

(3) Soak string or shoelaces in solution and braid three strands together. Allow to dry.

(4) Check burning rate.

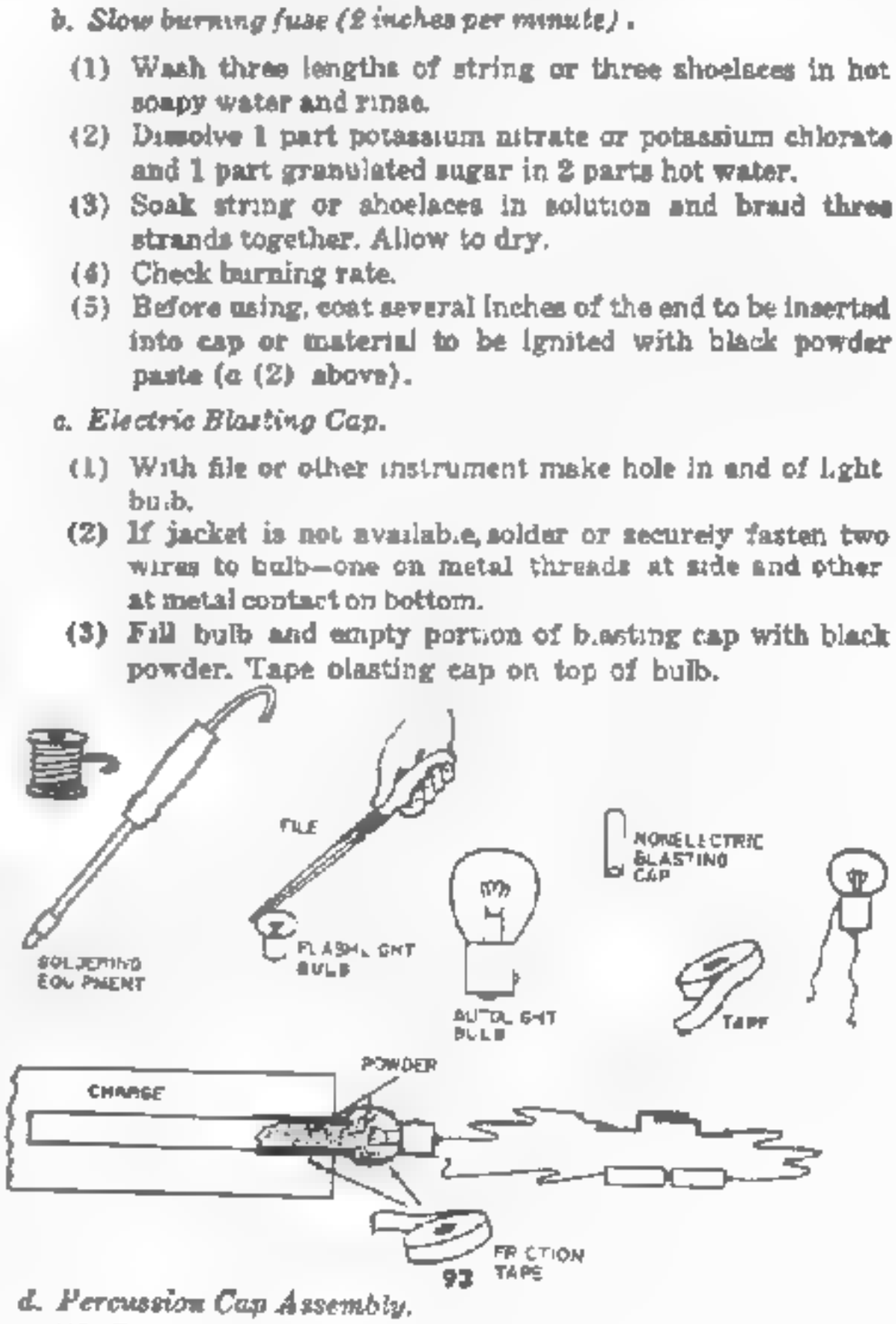
(5) Before using, coat several inches of the end to be inserted into cap or material to be ignited with black powder paste (a (2) above).

c. *Electric Blasting Cap.*

(1) With file or other instrument make hole in end of light bulb.

(2) If jacket is not available, solder or securely fasten two wires to bulb—one on metal threads at side and other at metal contact on bottom.

(3) Fill bulb and empty portion of blasting cap with black powder. Tape blasting cap on top of bulb.



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d. *Percussion Cap Assembly.*

(1) Remove projectile, but not powder, from small arms

cartridge.

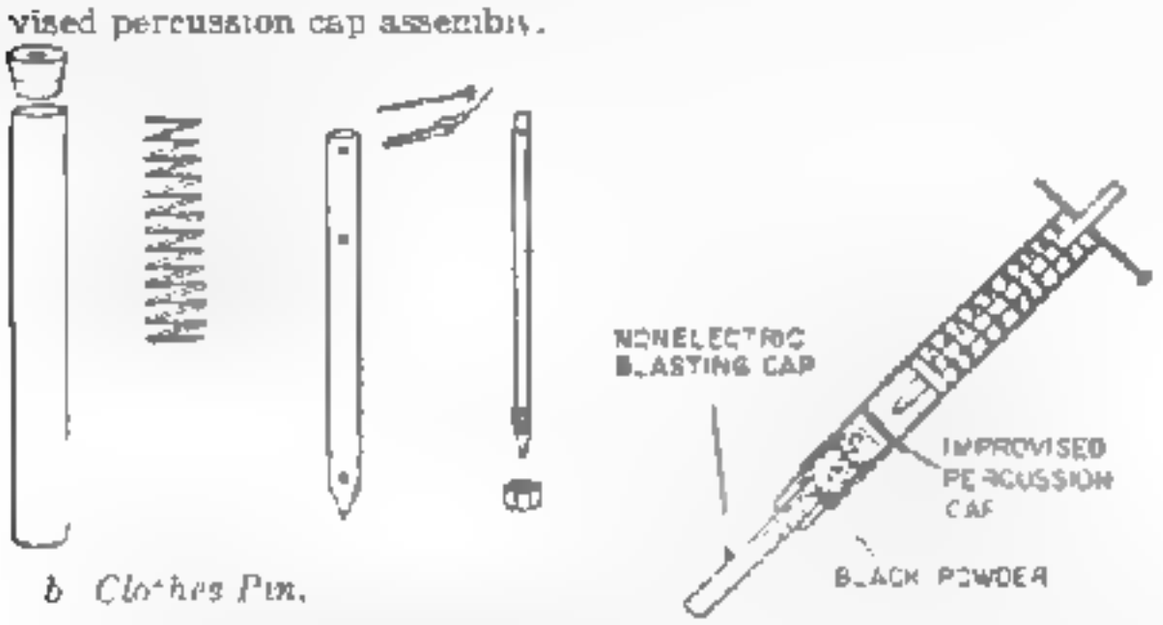
(2) Tape nonelectric blasting cap securely in cartridge.

55. Pull Firing Devices

a. Tube and Striker

Assemble tube, spring, striker shaft with hole or with hex nut, soft wood or metal top plug, pull pin and improvised percussion cap assembly

Note. Always assemble firing device before attaching the improvised percussion cap assembly.



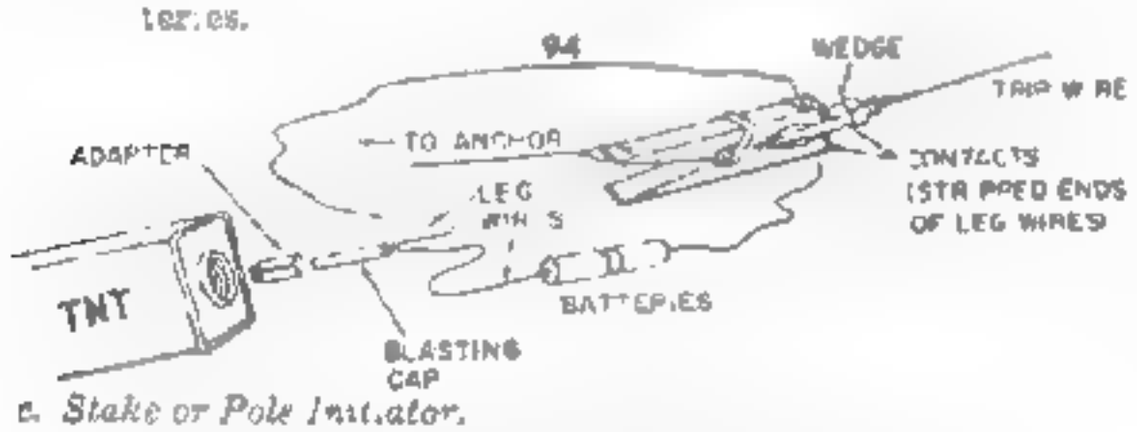
b. Clothes Pin.

(1) Wrap stripped ends of leg wires around clothes pin jaws to make electric contact

(2) Assemble charge, adapter, electric blasting cap, and clothes pin

(3) Insert wooden wedge, anchor clothes pin, and install trip wire.

(4) Check circuit with galvonometer *first*, then connect batteries.

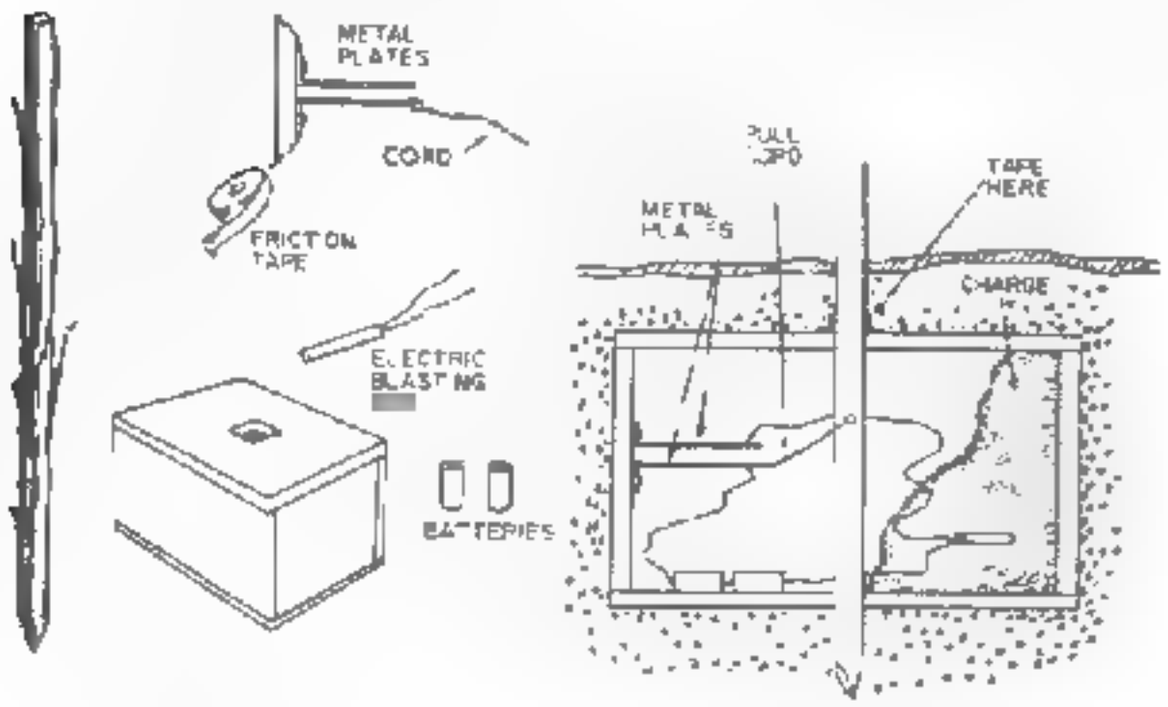


c. Stake or Pole Initiator.

(1) Assemble stake or pole, container, metal contact plates, charge, electric blasting cap, and pull cord.

(2) Check circuit with galvonometer *first*, then connect batteries.

(3) Fasten down top of container and seal hole around stake with friction tape



d. Rope and Cylinder.

(1) Cut leg wires to proper length

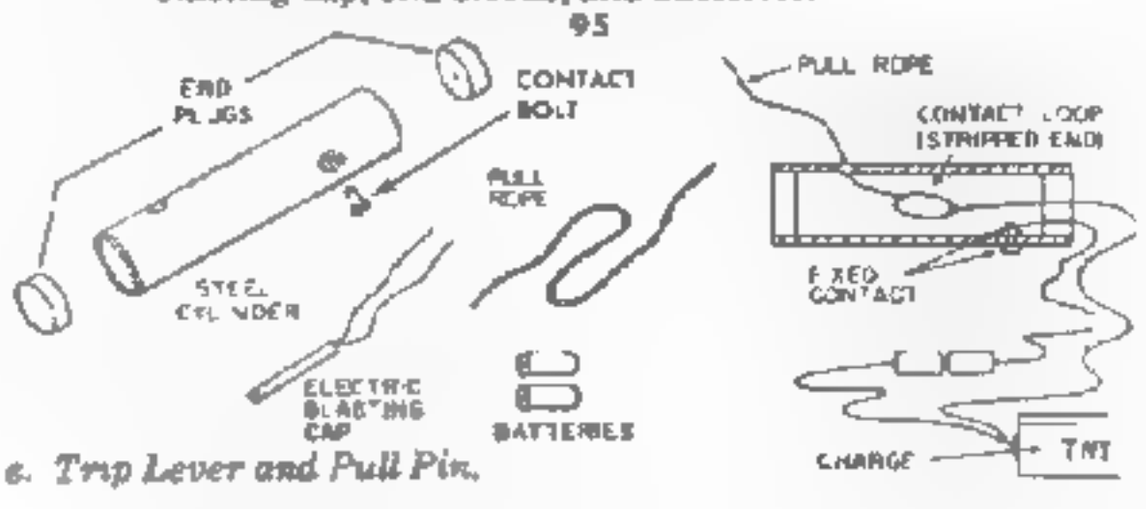
(2) Prepare wooden end plugs and bore hole in one to receive leg wires.

(3) Thread leg wires through hole in block

(4) Strip end of one leg wire and twist into loop, and secure other leg wire in position

(5) Test circuit with galvonometer

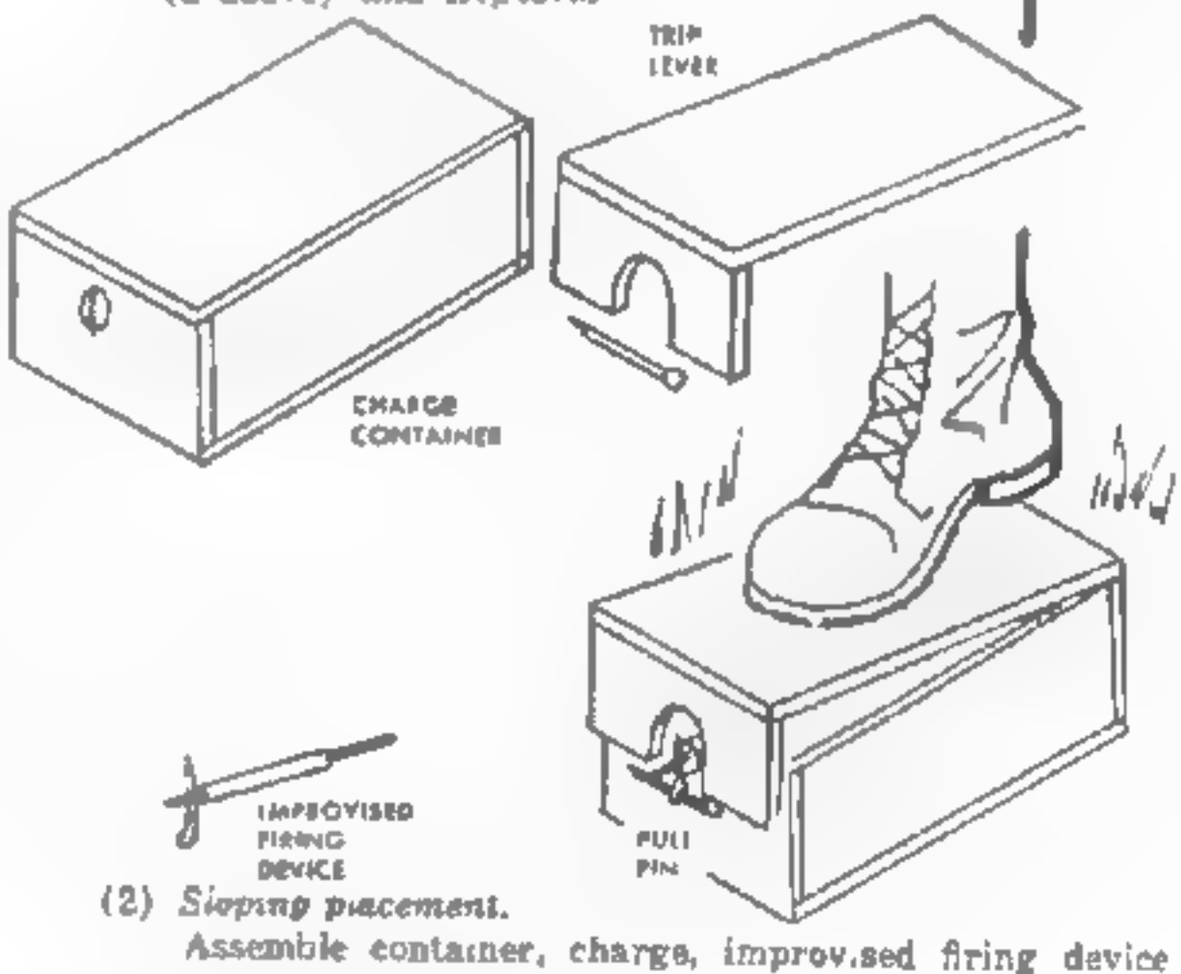
(6) Assemble metal cylinder, contact bolt, pull cord charge, blasting cap, end blocks, and batteries.



e. Trip Lever and Pull Pin.

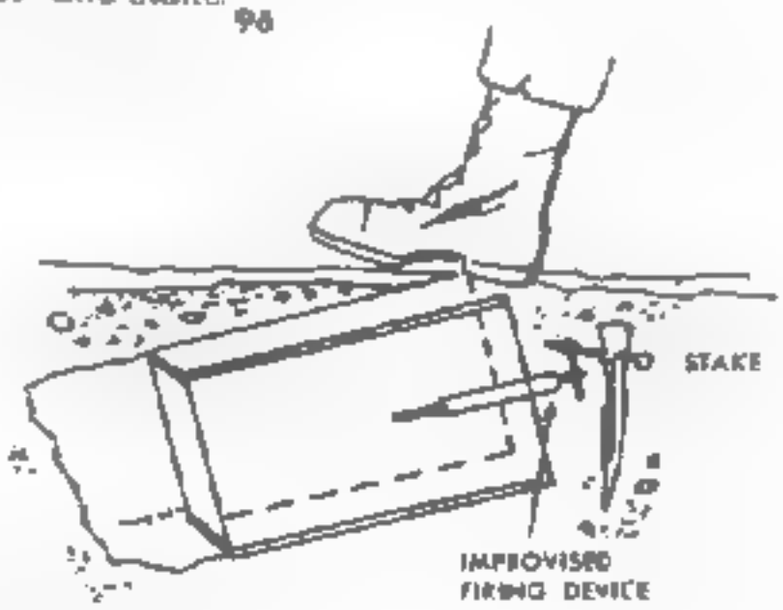
(1) *Flat placement.*

Assemble container, charge, improvised pull firing device (*a* above) and trip lever



(2) *Sloping placement.*

Assemble container, charge, improvised firing device (*a* above) and stake.



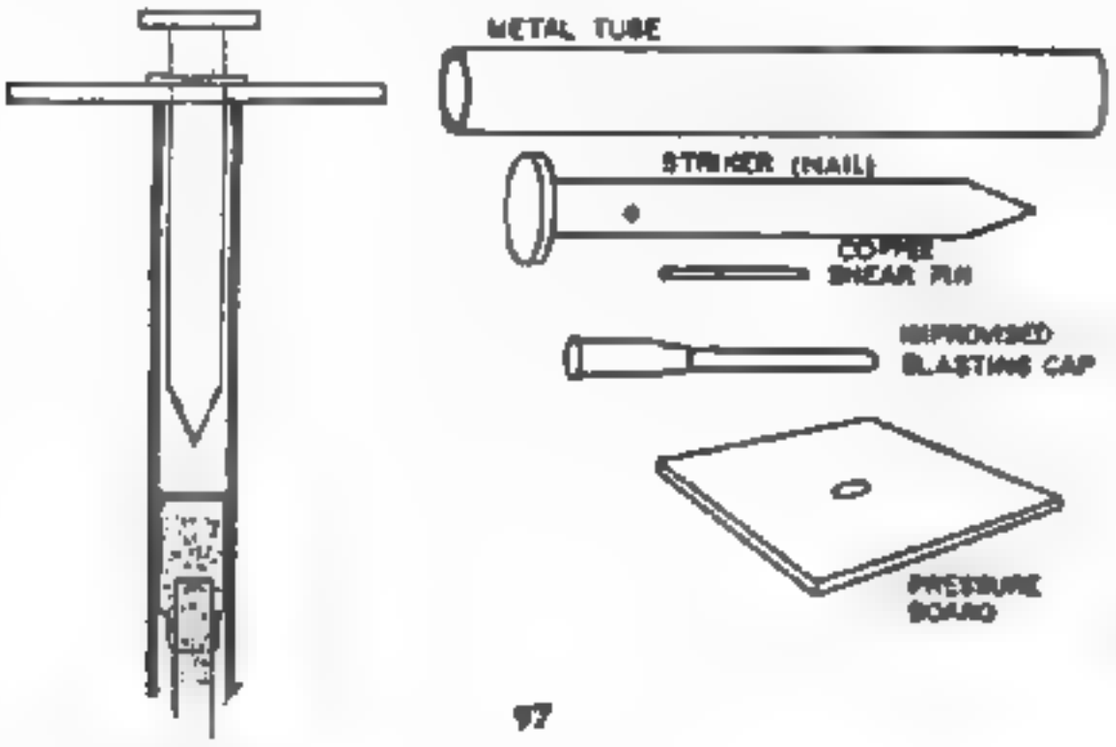
56. Pressure Firing Devices

a. Mechanical Concussion.

(1) Force striker into hole in pressure board.

(2) Insert wood or soft metal shear pin in shear pin hole.

(3) Assemble striker, metal tube, and improvised blasting cap (para 64).



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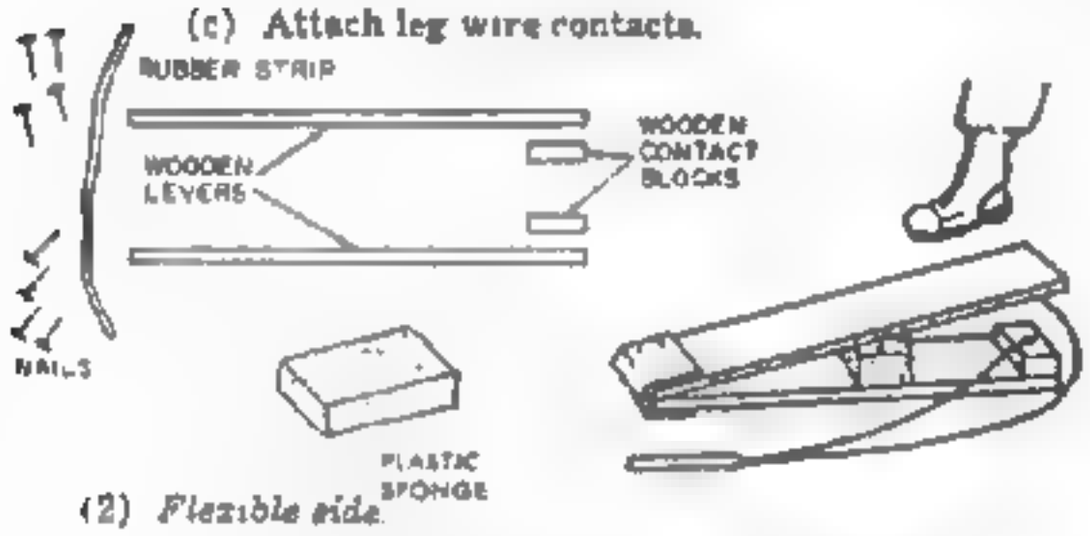
b. Electrical.

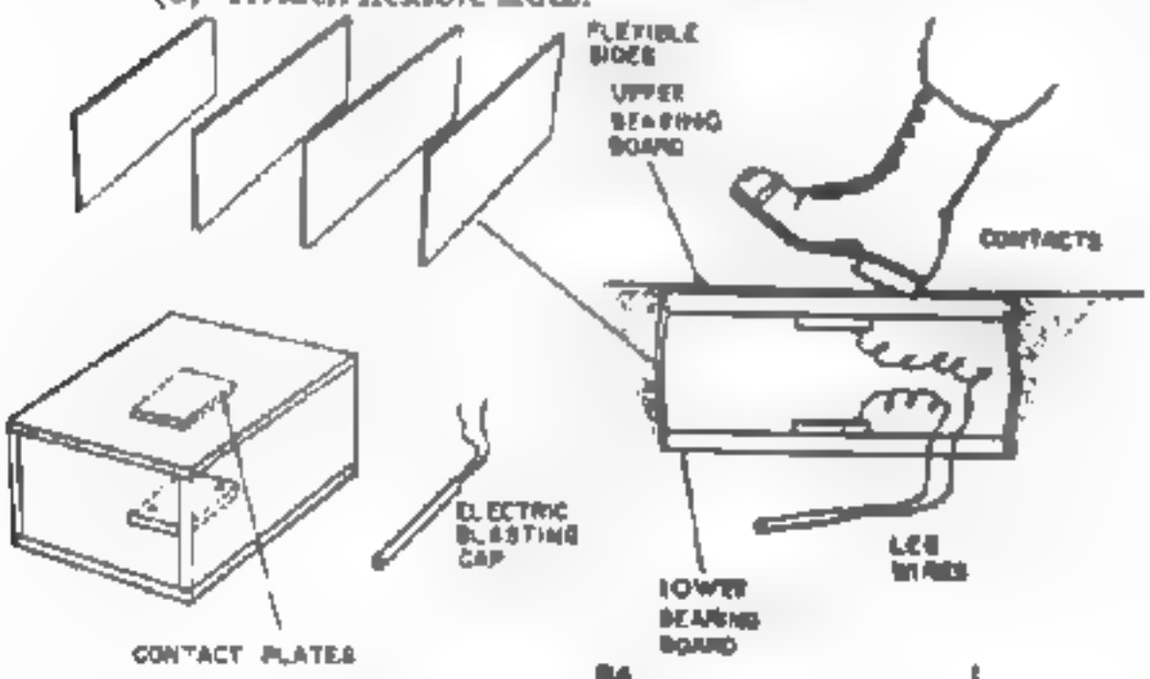
(1) *Lever arm.*

(a) Attach contact blocks to ends of wooden levers.
(b) Assemble wooden levers, rubber strip, and plastic sponge.
(c) Attach leg wire contacts.



(2) *Flexible side.*

(a) Attach metal contact plates to bearing boards.
(b) Thread leg wires through holes in lower bearing board and attach to contact plates.
(c) Attach flexible sides.



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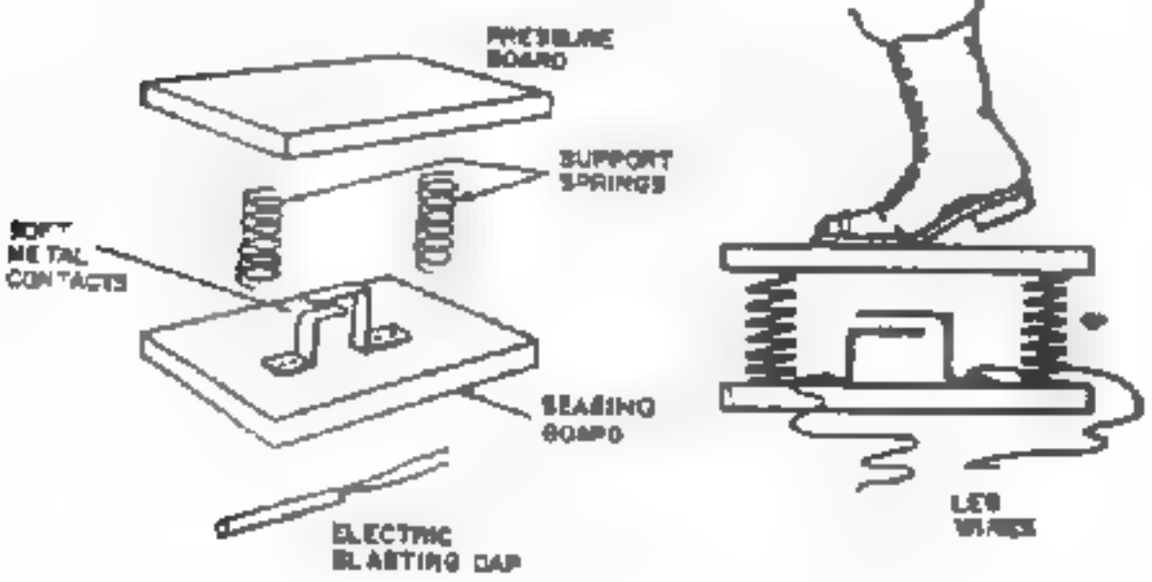
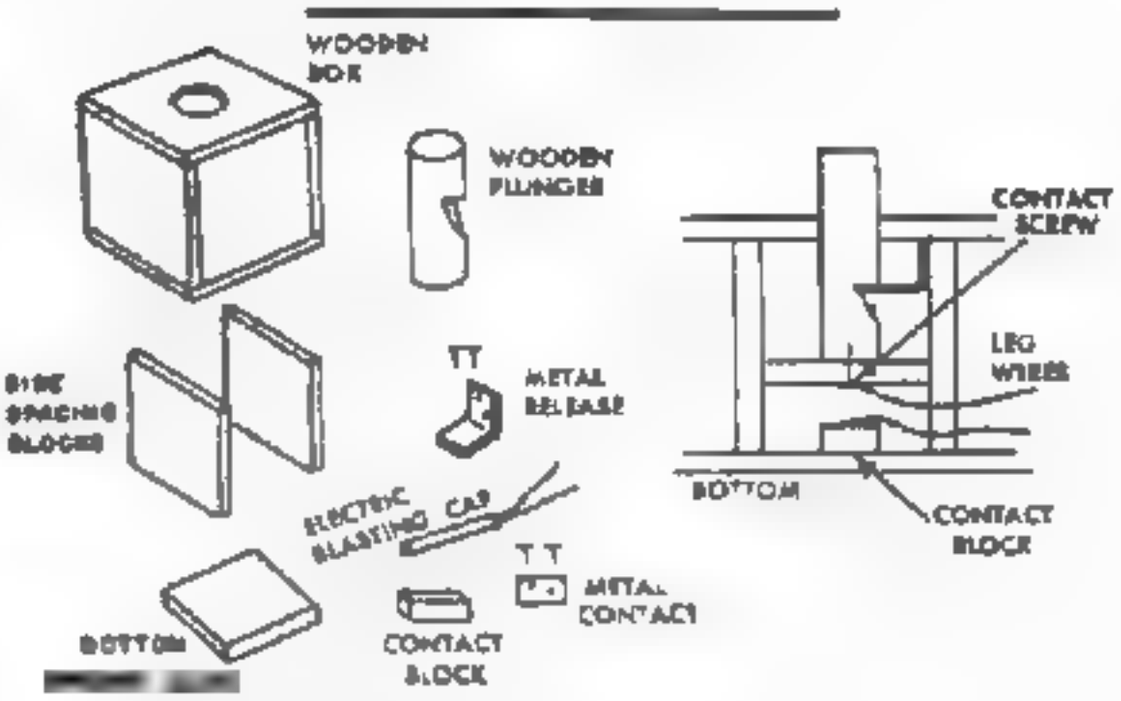


(2) *Springed pressure board.*

(a) Assemble metal contacts, springs, bearing board, and pressure board.
(b) Attach leg wires to metal contacts.



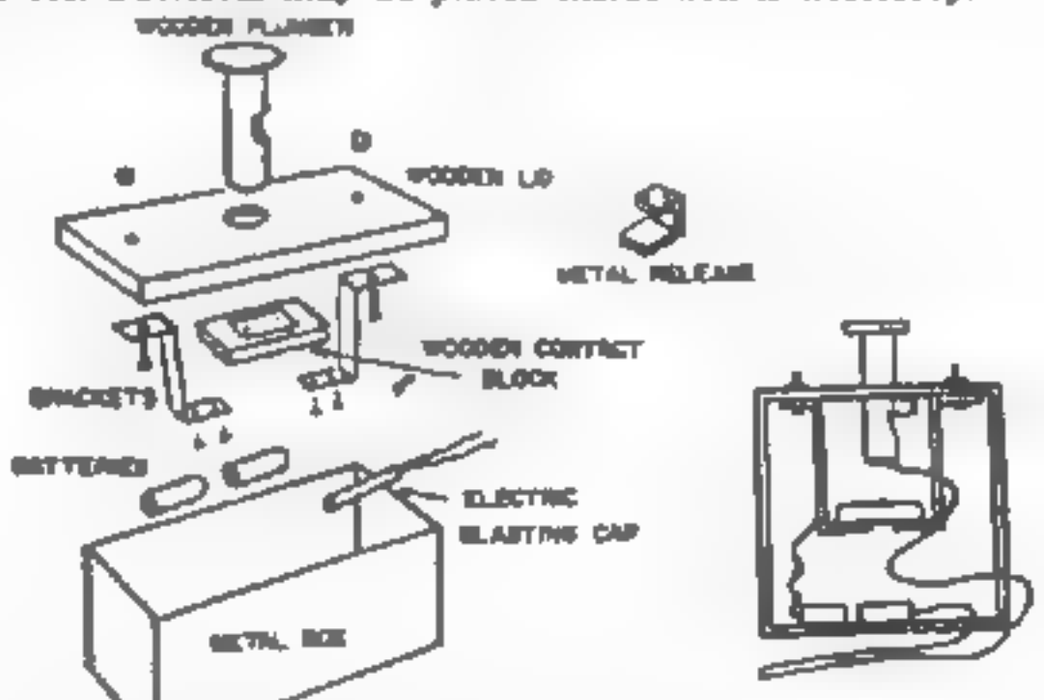
(4) *Wooden plunger.*

(a) Assemble box, leaving one side open.
(b) Assemble contact plate and three spacing blocks inside box.
(c) Drill holes in spacing block for leg wires.
(d) Assemble plunger, metal release, contact block, metal contact, and contact screw.
(e) Thread leg wire through holes in spacing block and attach to contacts.

(5) *Metal box*

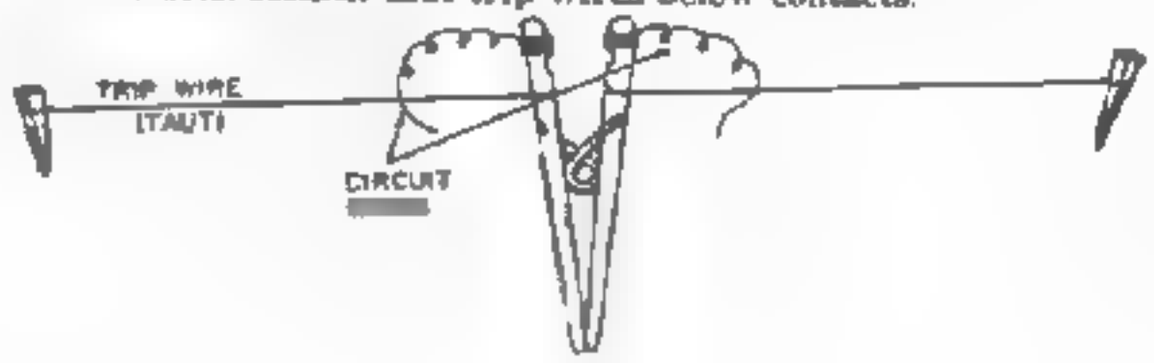
(a) Attach metal contact to wooden contact block.
(b) Assemble contact block and metal contact, brackets, metal release, plunger, and wooden box lid.
(c) Bore hole in side of box for leg wires.
(d) Thread leg wires through hole in box.
(e) Attach one leg wire to plunger, the other to metal contact.

Note. Batteries may be placed inside box if necessary.



37. Tension-Release Firing Device

Attach stripped ends of circuit wires to ends of clothes pin to form contacts. Attach taut trip wires below contacts.



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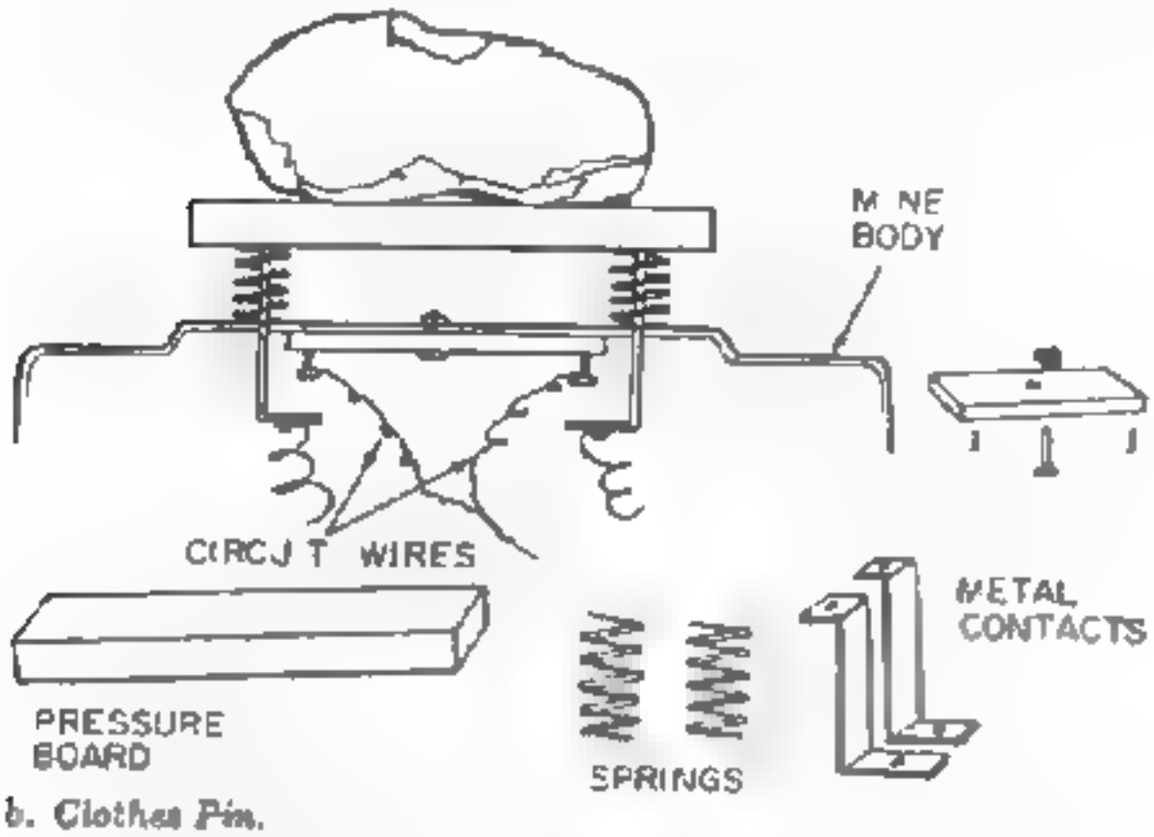
58 Pressure-Release

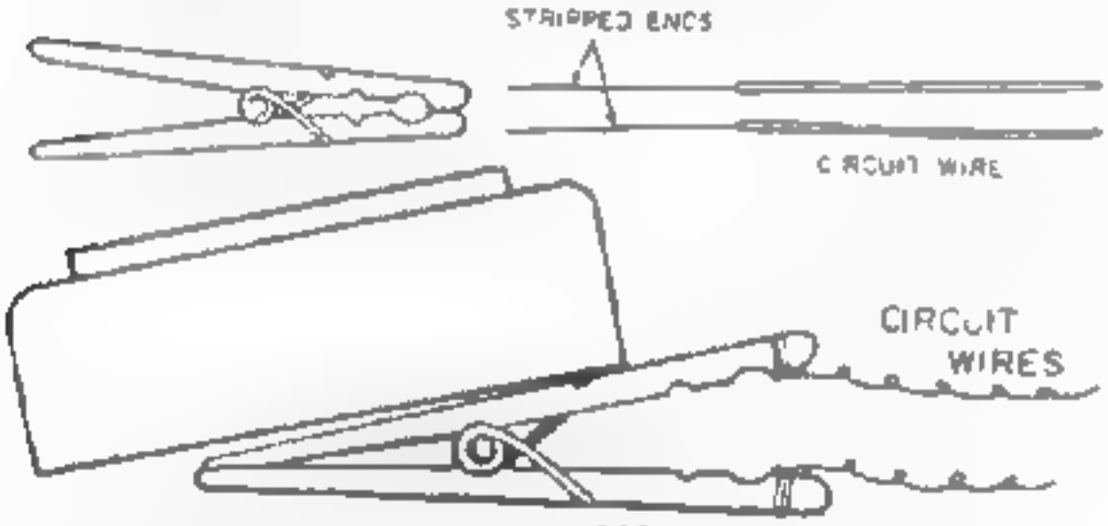
a. Double Contact.

(1) Bore holes in top of mine body to accommodate long contacts.
(2) Assemble pressure board, coil springs, wooden contact board and metal contacts.
(3) Attach circuit wires.



b. Clothes Pin.

(1) Attach stripped ends of circuit wires to clothes pin to make contacts.
(2) Place mine on top, keeping contacts apart.



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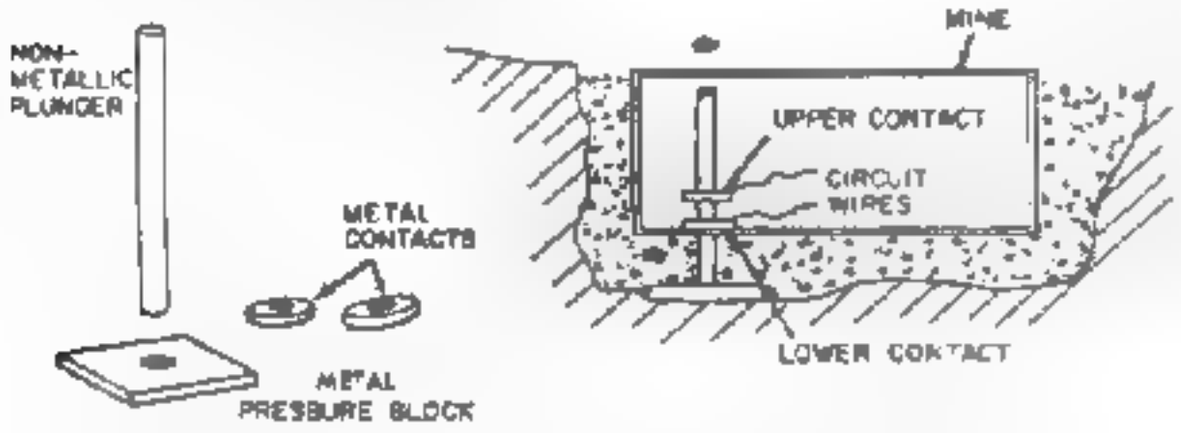
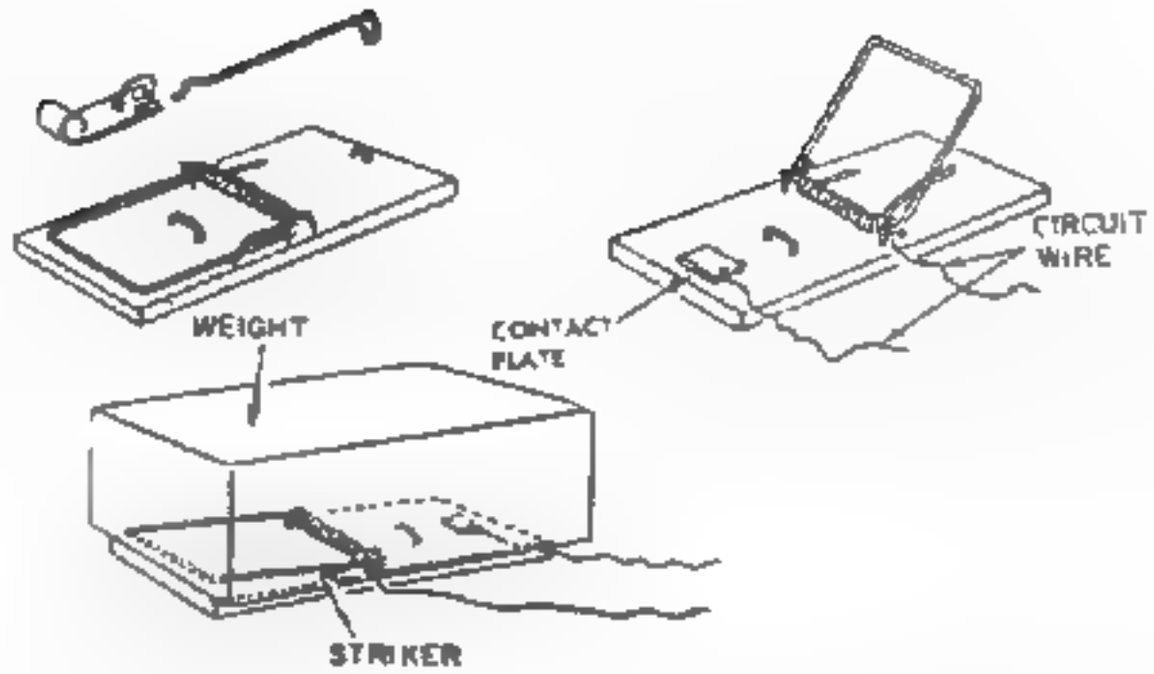
c. Bottom Plunger.

(1) Bore hole in bottom of mine case to admit plunger.
(2) Attach lower metal contact over hole.
(3) Assemble mine, pressure block, upper metal contact, and nonmetallic plunger.
(4) Attach circuit wires.



d. Mousetrap.

(1) *Mechanical*
See para 44 *b* (2)
(2) *Electrical*
(a) Remove triggering devices from mousetrap.
(b) Assemble trap, contact plate, and circuit wires.
(c) Place weight on top with striker in armed position.



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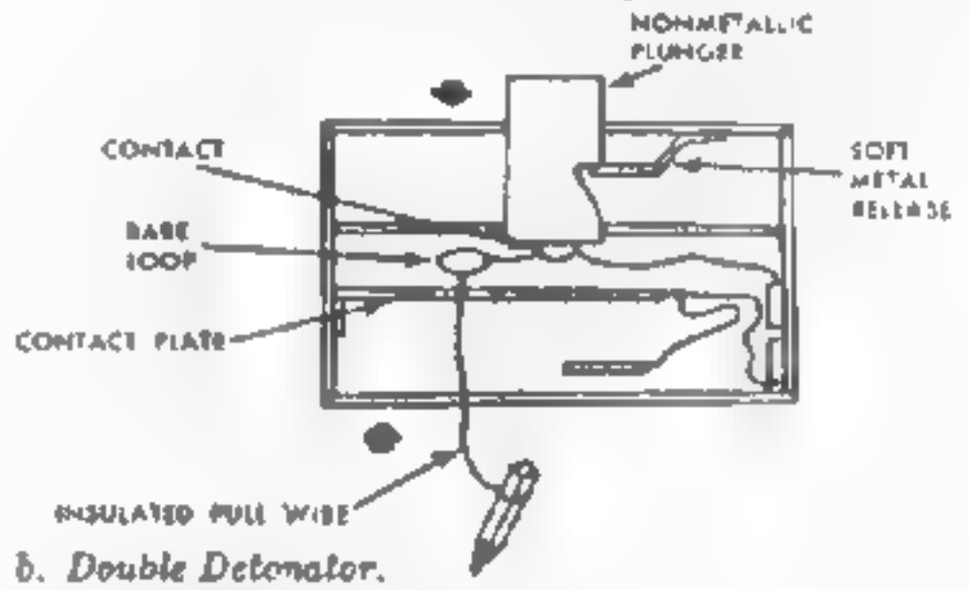
59 Anti-Lift Devices

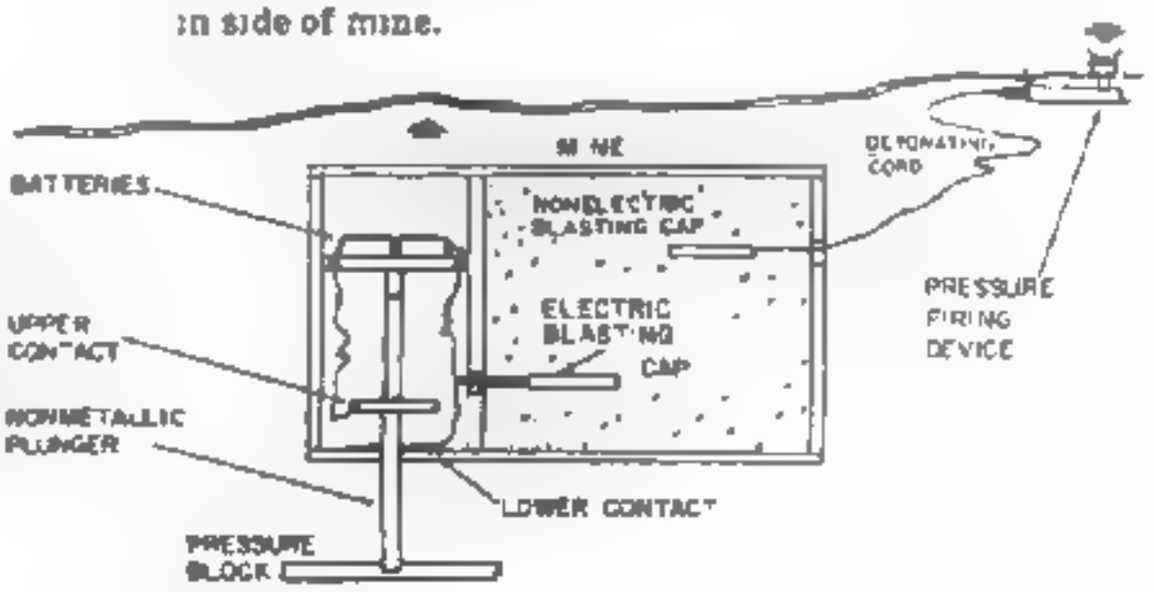
a. Loop Contact.

(1) Drill hole in bottom of mine to admit insulated pull wire.
(2) Assemble plunger, metal release, and contact plate.
(3) Attach circuit wires and bare loop to plunger contact and contact plate.
(4) Thread anchored insulated trip wire through holes in bottom of mine and contact plate and attach to bare loop.



b. Double Detonator.

(1) Drill three holes—one in bottom, one in partition, and one in side—to admit nonmetallic plunger and two electric blasting caps.
(2) Assemble blasting cap, leg wires, contact plates, plunger and pressure block.
(3) *Check circuit with galvanometer first.* Then connect batteries with friction tape.
(4) Install blasting cap connected to pressure firing device in side of mine.



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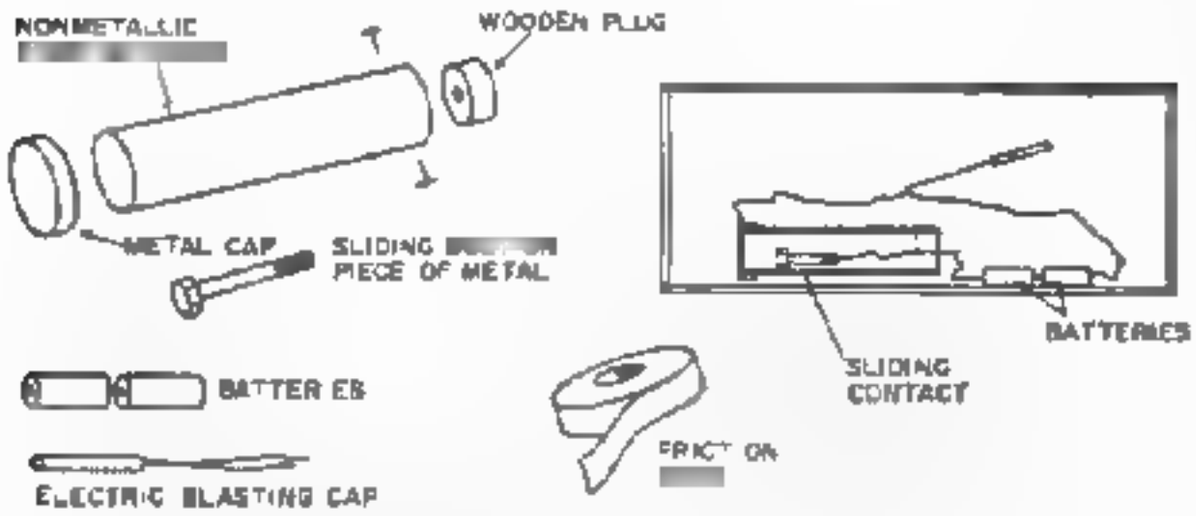
e. Sliding Contact.

(1) Assemble metal cap, nonmetallic tube or carton, sliding contact, wooden plug and leg wires at contacts.
(2) *Check circuit with a galvanometer first,* then connect batteries with friction tape.
(3) Install assembly in tube.



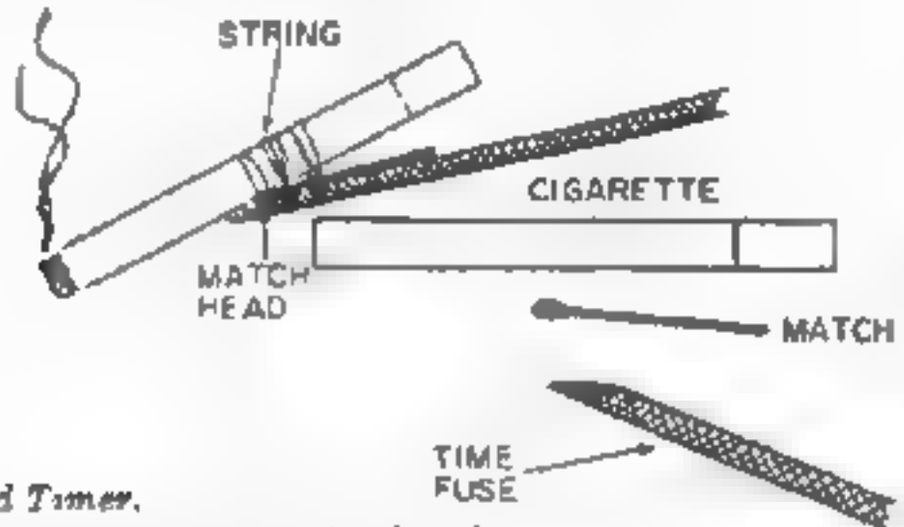
60 Delay Firing Devices

a. *Cigarette Timer*

(1) Test burning rate of time fuze and cigarette. (A cigarette usually burns at the rate of 1 inch in 7 to 8 minutes.)

(2) Cut sloping end on length of time fuze.

(3) Assemble sloped end of time fuze, match head, and cigarette.

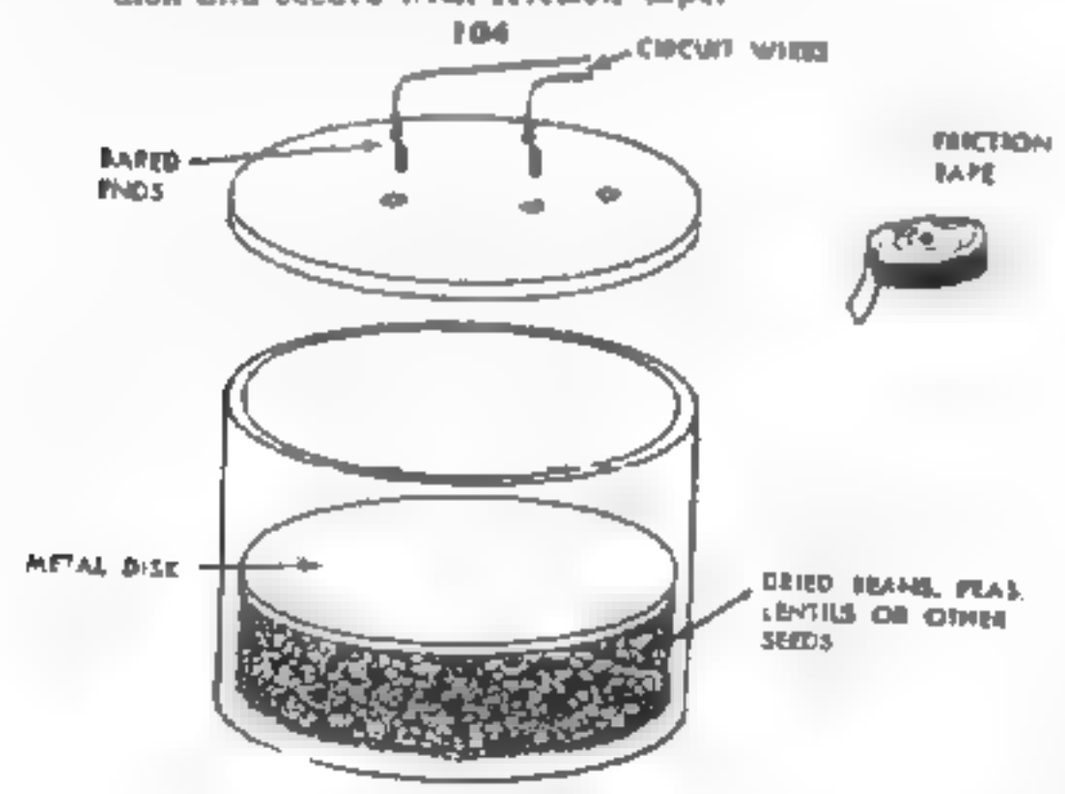


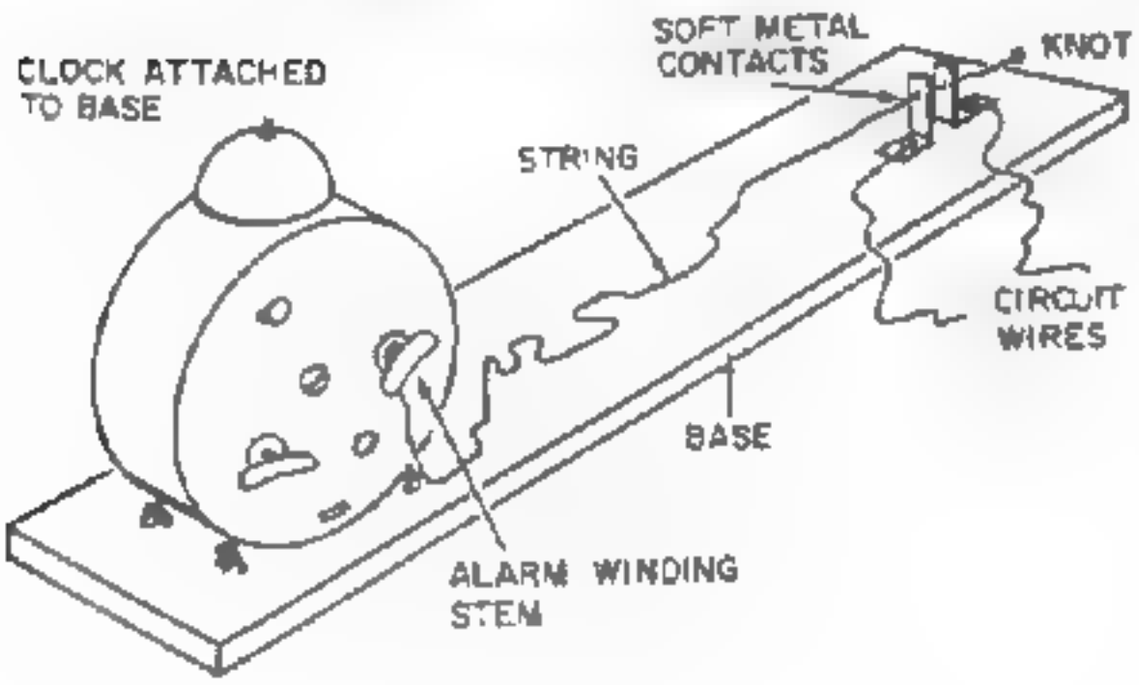
b. *Dried Seed Timer.*

(1) Determine expansion rate of seeds.

(2) Place in jar and add water

(3) Assemble jar, lid, circuit wires, metal contacts, and metal disk and secure with friction tape.





a. *Alarm Clock Timers.*

(1) *Electric.*

(a) Assemble base, metal contacts, and alarm clock.

(b) Tie knot in one end of string. Thread other end through metal contacts and attach to alarm winding stem, which winches string and closes circuit.

Note. An alarm clock, being a very versatile delay, may be connected in many other ways.

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(2) *Nonelectric.*

(a) Drill hole in board of proper size to hold standard base tightly

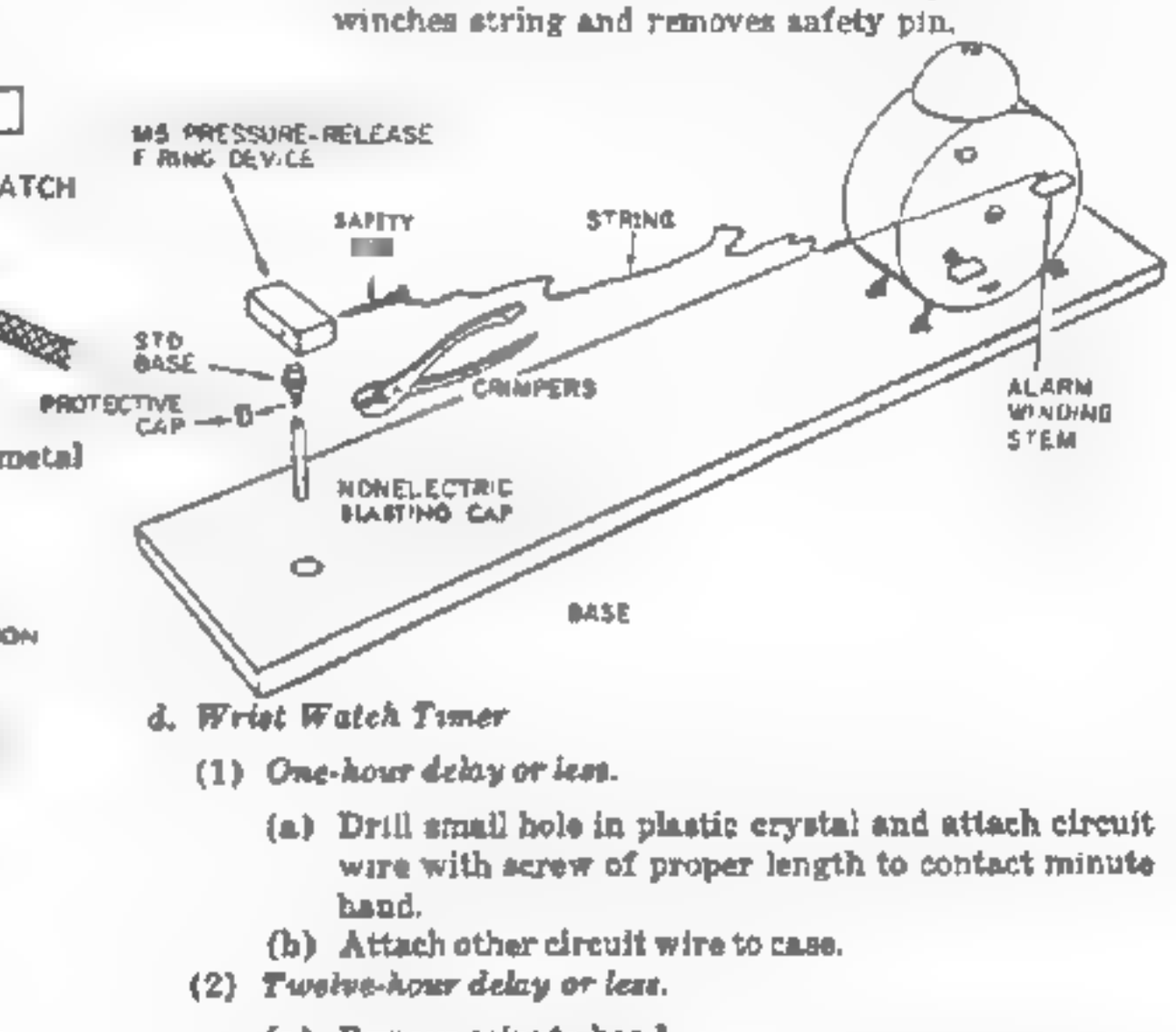
(b) Remove standard safety pin from firing device and replace with easily removed pin.

(c) Remove protective cap from standard base and crimp on nonelectric blasting cap.

(d) Screw standard base with blasting cap into firing device.

(e) Assemble alarm clock and firing device on board.

(f) Attach one end of length of string to eye in safety pin and the other to alarm winding stem which winches string and removes safety pin.



d. *Wrist Watch Timer*

(1) *One-hour delay or less.*

(a) Drill small hole in plastic crystal and attach circuit wire with screw of proper length to contact minute hand.

(b) Attach other circuit wire to case.

(2) *Twelve-hour delay or less.*

(a) Remove minute hand.

(b) Drill small hole in plastic crystal and attach circuit wire with screw of proper length to contact hour hand.

(c) Attach other circuit wire to case.

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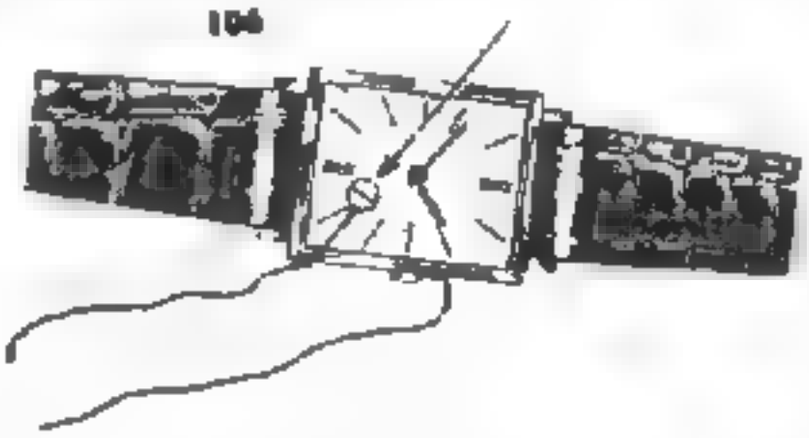


61. Bombs

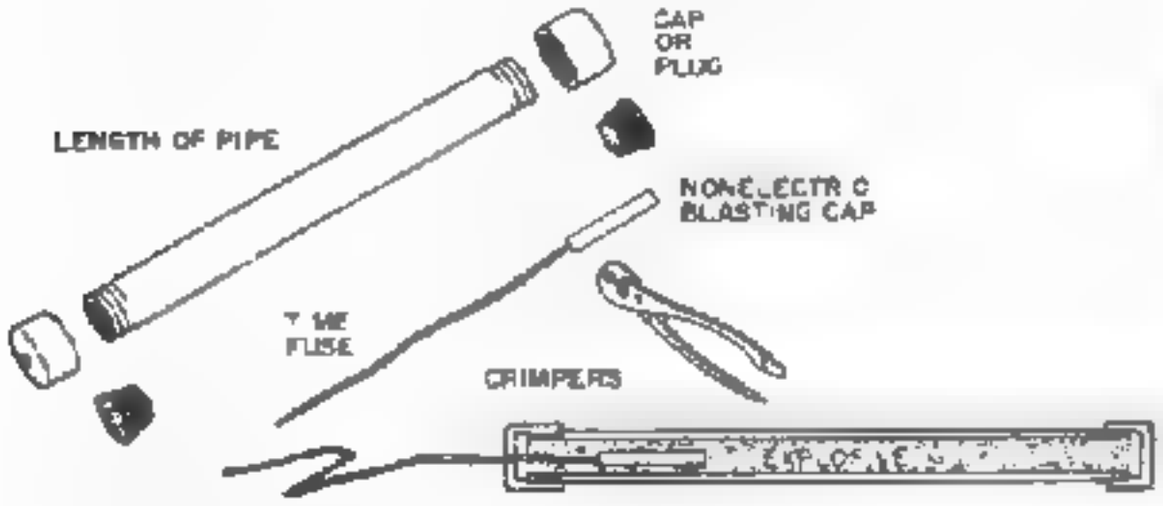
a. *Pipe Bombs.*

(1) *Grenade.*

(a) Drill hole in cap or plug to admit length of time fuze.

(b) Crimp nonelectric blasting cap to length of time fuze.

(c) Assemble pipe, caps or plugs, time fuze primer, and explosive charge.



(2) *Antidisturbance bomb.*

(a) Drill hole in end cap to admit length of burnt time fuze to make a bomb look like a "dud."
(b) Attach electric cap and mercury element on base.
(c) Test circuit with galvonometer *first*, then connect batteries with friction tape
(d) Assemble bomb.

Caution: If possible, assemble bomb in *place*, as the mercury element, when disturbed, may cause premature explosion. To assemble more safely and easily, attach wrist watch timer in circuit.

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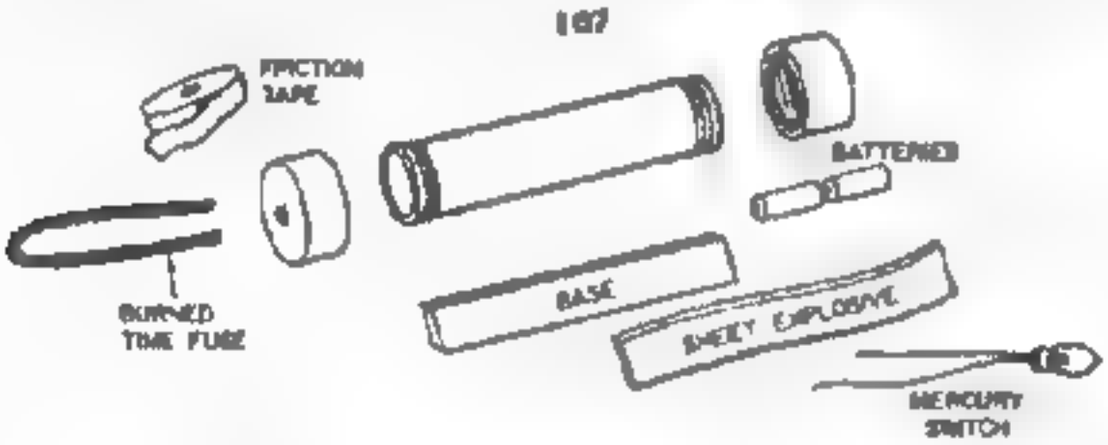
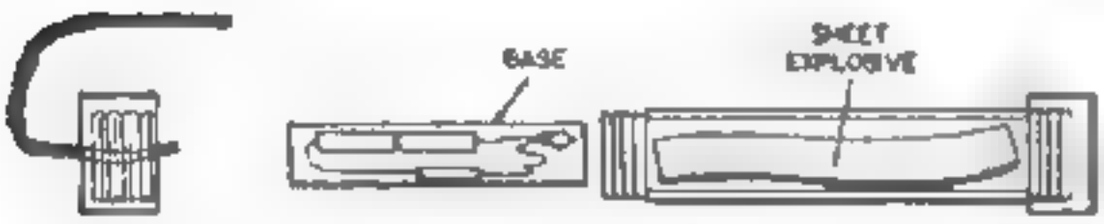
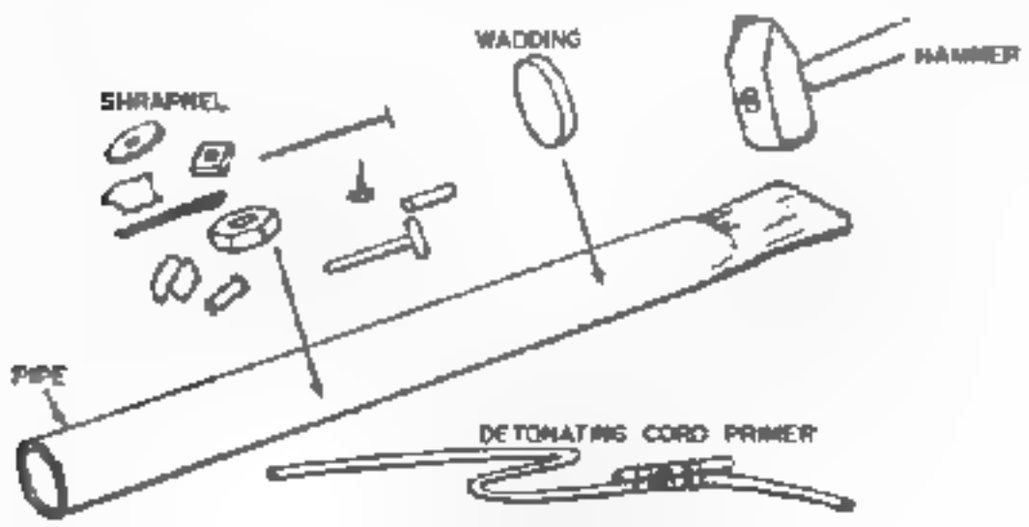




(3) *Shotgun bomb*

(a) Close one end of pipe with hammer, allowing opening for detonating cord primer or electric blasting cap.
(b) Remove protective cap from M1A1 pressure or M1 pull firing device and crimp on nonelectric blasting cap.
(c) Screw standard base with blasting cap into firing device.
(d) Assemble pipe, shrapnel, wadding, explosive, nonelectric primer or electric blasting cap (for controlled firing), and proper firing device.

Note. The force of the explosive and the strength of the pipe are important in calculating the size of the charge.



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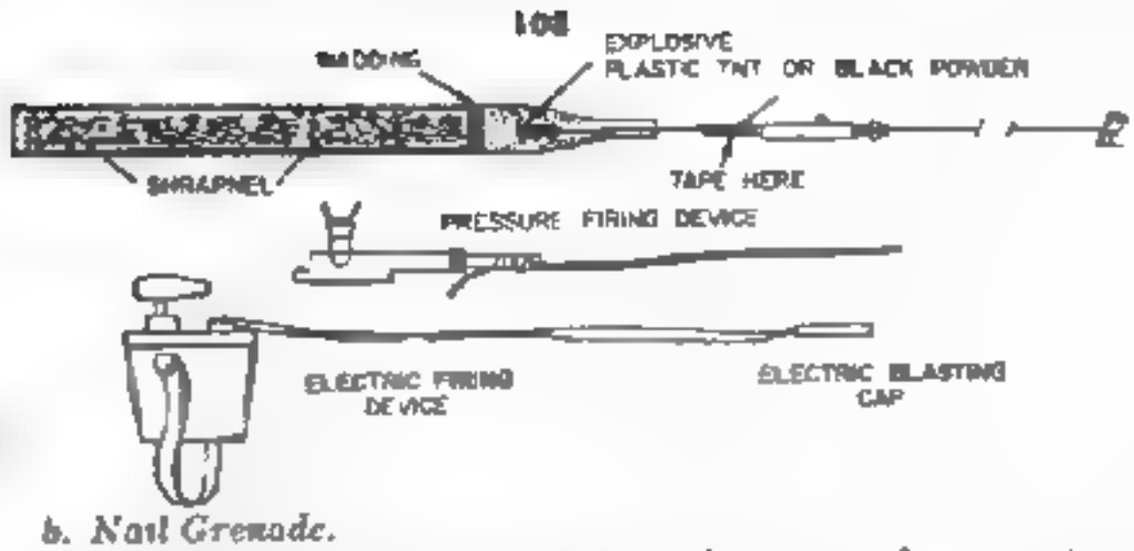
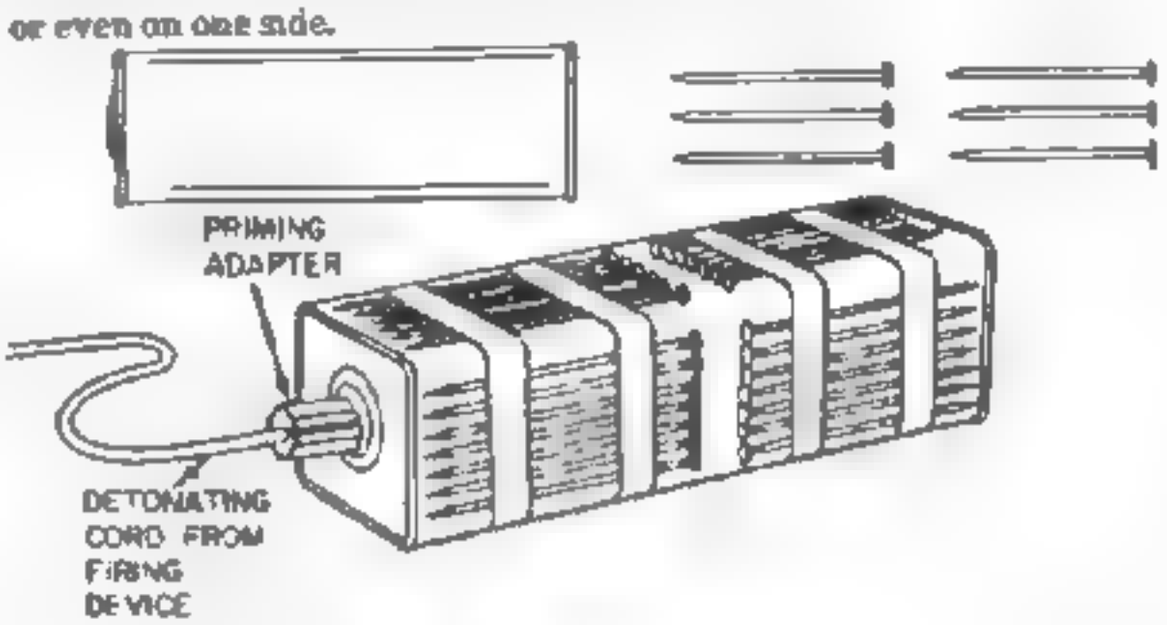


b. Nail Grenade.

Attach nails to top and sides of charge by means of tape or string. Under certain conditions, nails may be required on only two sides, or even on one side.

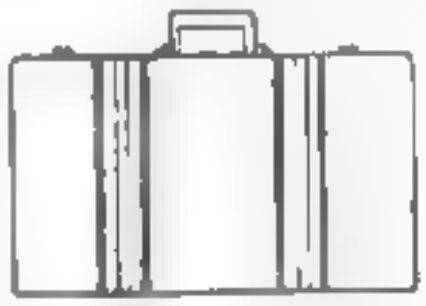


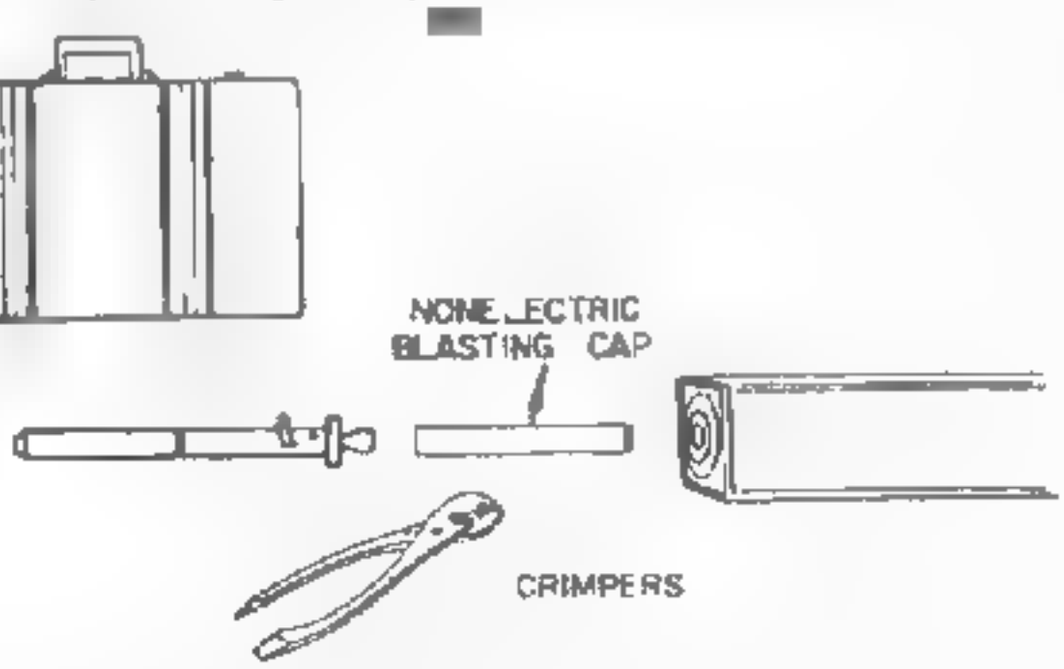
c. Delay Bomb.

(1) *Chemical delay.*

(a) Crimp nonelectric blasting cap on base of appropriate M1 delay firing device
(b) Assemble firing device and charge in package.
(c) Crush copper end of firing device with fingers.
(d) Place package in suitcase or container.

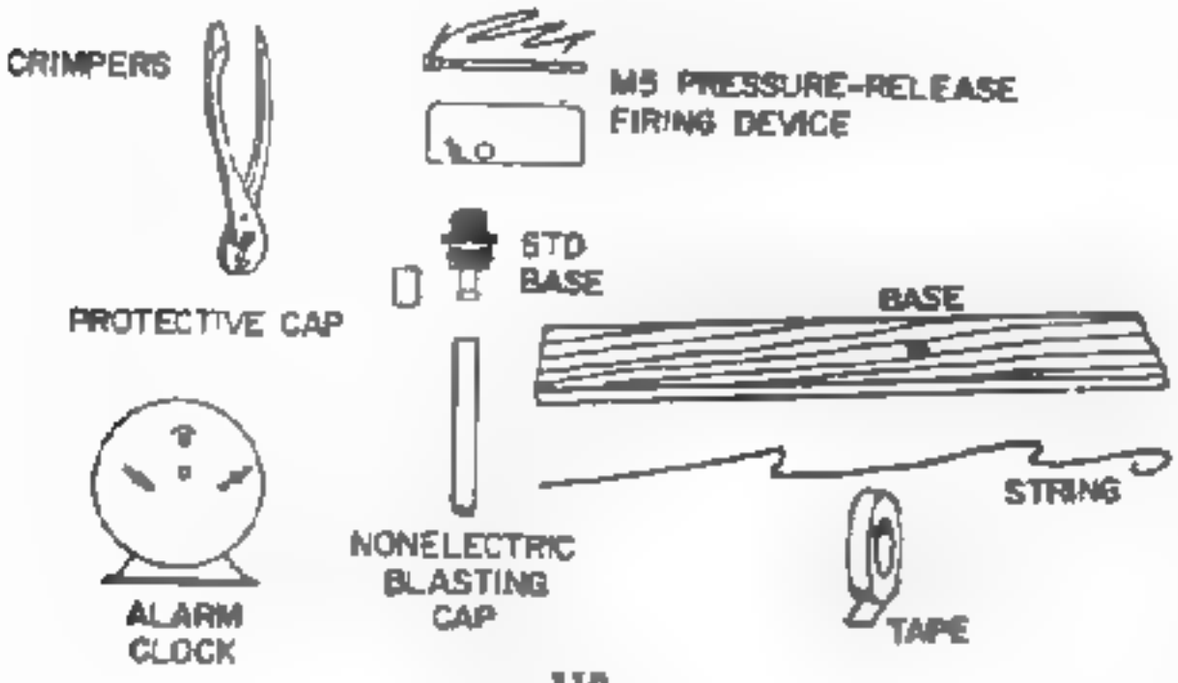
Note. Use this bomb only when delay is necessary but accuracy is secondary, as the delay time of any chemical firing device varies considerably according to temperature.

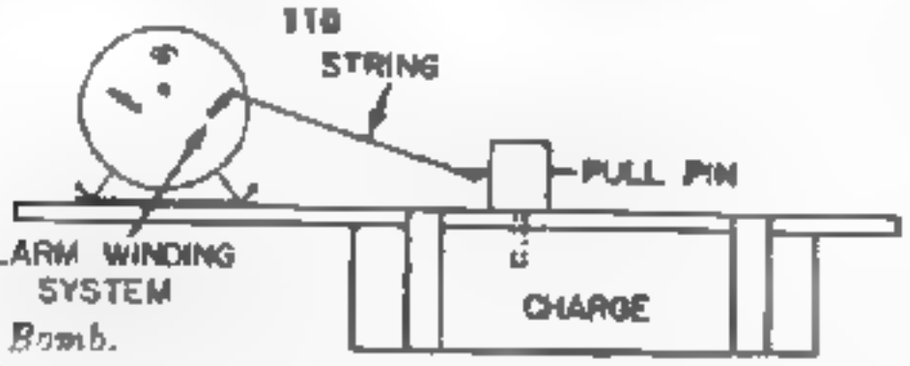




(2) *Alarm clock delay.*

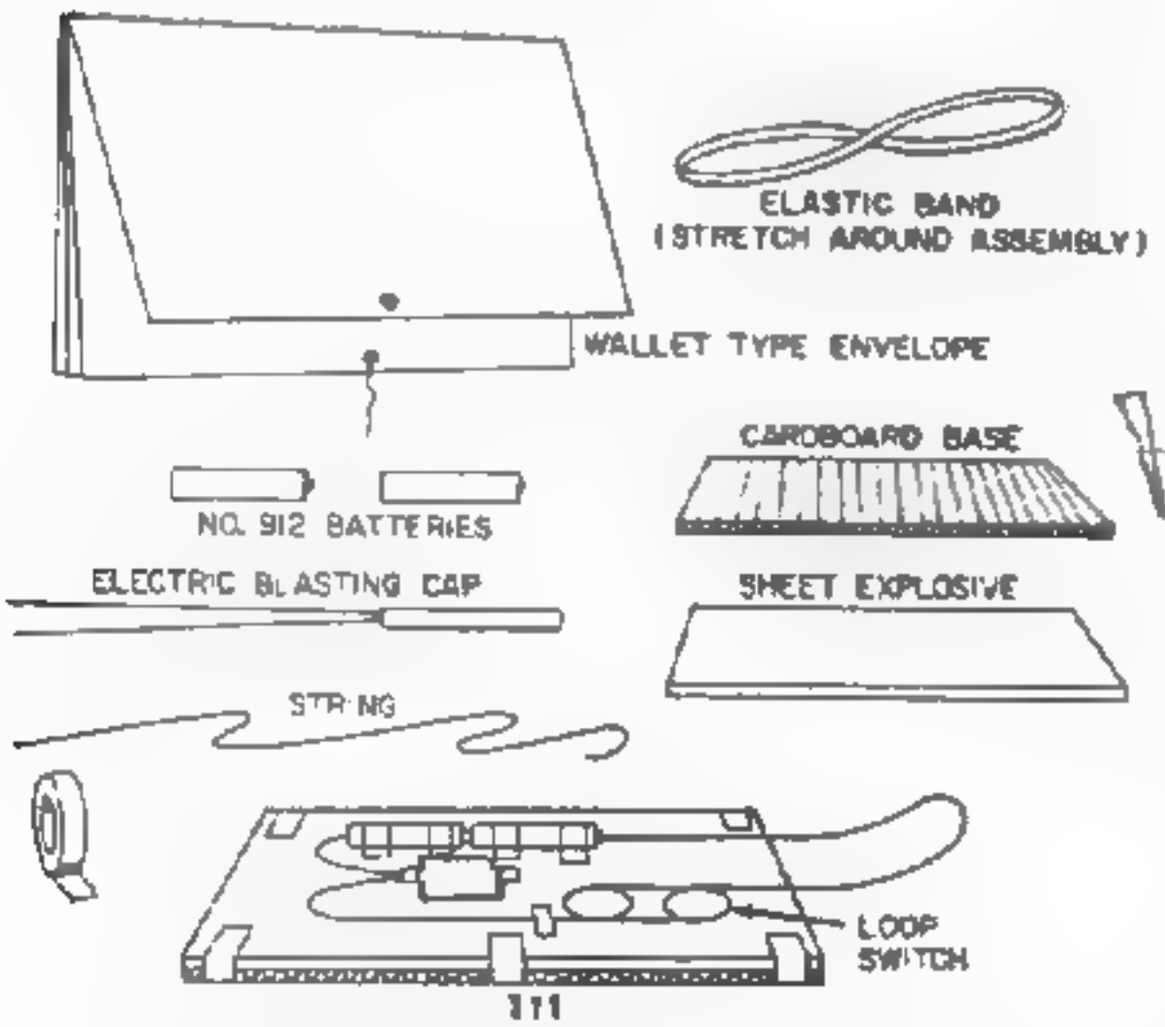
(a) Drill hole in wooden base of proper size to hold standard base firmly
(b) Remove standard safety pin from M5 pressure-release firing device and replace with easily-removed pin.
(c) Crimp nonelectric blasting cap on standard base and attach to firing device
(d) Assemble alarm clock and firing device on wooden base.
(e) Attach one end of string in eye in pull pin and the other to the alarm winding stem so that its turning will winch the string and withdraw the pin.
(f) Place assembly in suitcase or container.





d. Envelope Bomb.

(1) Cut leg wires of electric blasting cap of proper length to make circuit.
(2) Strip insulation off ends of circuit wires and twist into ¼-inch loops to make loop switch.
(3) Test circuit with galvonometer *first*, then attach batteries.
(4) Assemble cardboard base, batteries, electric blasting cap, and explosive as package.
(5) Attach one end of string to loop switch so that it will pull the bared loops together to close circuit.
(6) Cut hole inside of envelope under flap.
(7) Fix package in envelope firmly and thread string through hole.
(8) Attach string firmly but concealed to underside of flap.
(9) Close envelope with elastic band.



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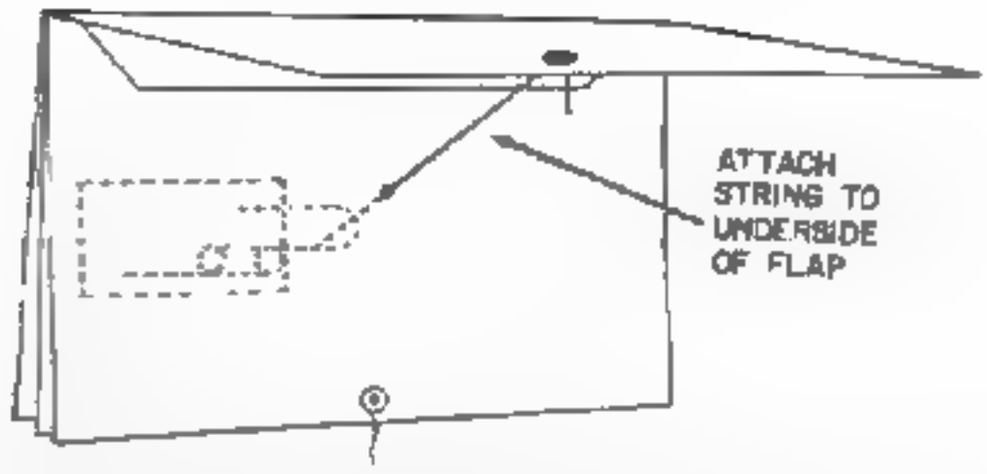
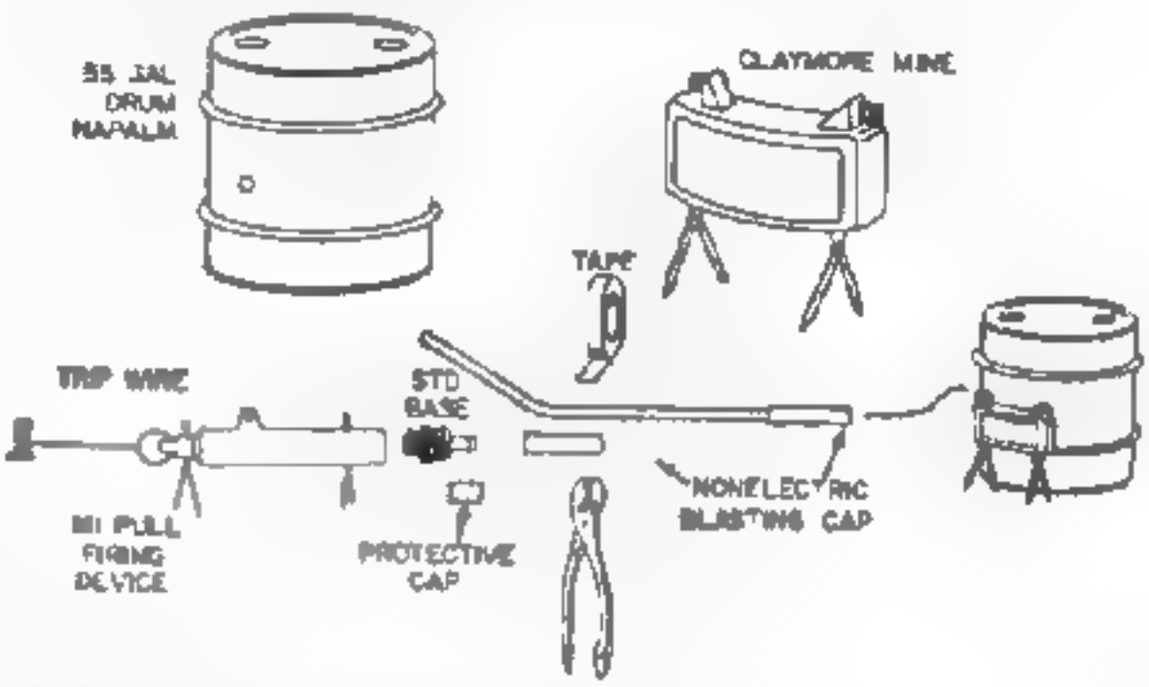
e. Hot Shrapnel Bomb.

(1) Remove protective cap from standard base and crimp on nonelectric blasting cap.
(2) Screw base with cap in M1 pull firing device.
(3) Crimp nonelectric blasting cap on one end of length of detonating cord, and install in Claymore mine.

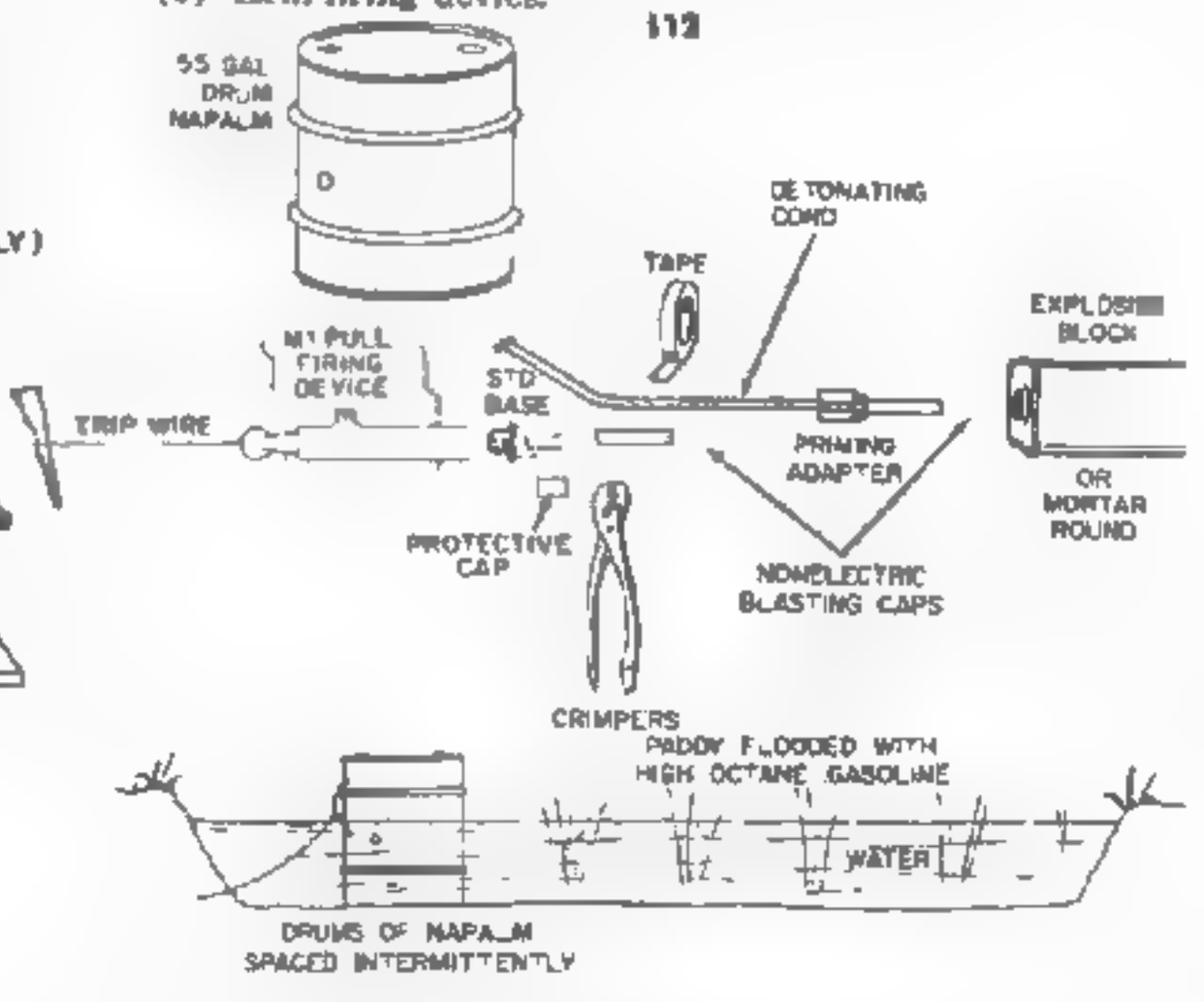


(4) Attach firing device to detonating cord with tape.
(5) Assemble Claymore mine with priming and firing accessories and drum of napalm.
(6) Arm firing device.



f. Rice Paddy Bomb.

(1) Remove protective cap from standard base and crimp on nonelectric blasting cap
(2) Screw standard base with cap into M1 pull firing device.
(3) Assemble firing device, detonating cord, priming adapter, nonelectric blasting cap, and explosive charge.
(4) Attach charge to drum of napalm.
(5) Arm firing device.



g. Tin Can Bomb.

(1) Cut a notched metal contact disk to provide clearance for length of stiff insulated wire and ⅛ to ¼ in. from walls of can.
(2) Cut stiff insulated wire of proper length to support disk and strip insulation from both ends. Bend hook on one

end to hold bare suspension wire.
(3) Bend stiff wire to proper shape.
(4) Assemble can, explosive, contact to can, blasting cap, insulated support wire, suspension wire and contact disk.
(5) Check circuit with galvanometer *first*, then connect batteries.

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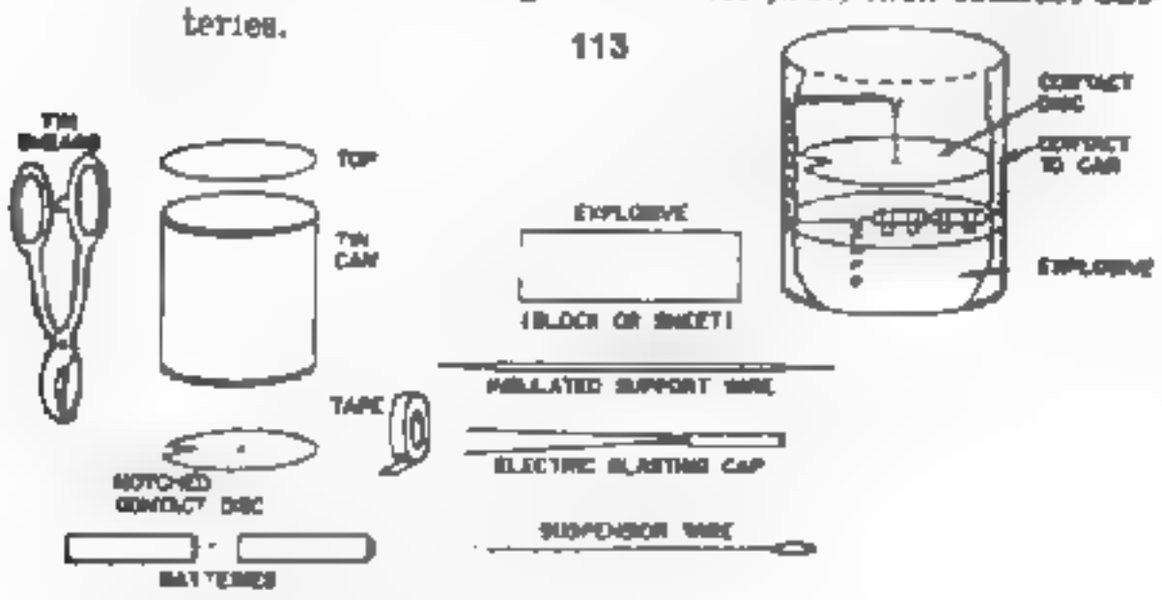
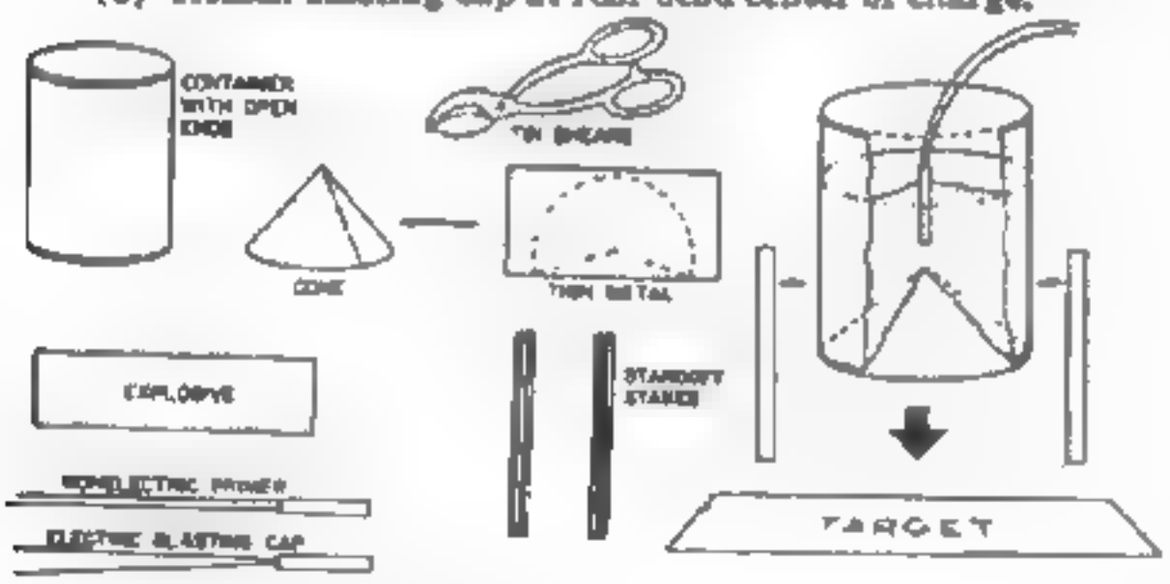


62. Miscellaneous Charges

a. Improvised Shaped Charge.

(1) Cut strip of thin metal to make cone of 30° to 60° angle to fit snugly into container.
(2) Place cone in container.
(3) Pack explosive firmly in container to a level of 2x height of cone.
(4) Attach standoffs to set charge above target at height of 2x diameter of cone.
(5) Attach blasting cap at rear dead center of charge.



b. Improvised Antipersonnel Mine.

(1) Assemble container, explosive, separator, and shrapnel. *Explosive must be packed to uniform density and thickness* (should be ¼ weight of shrapnel).
(2) Remove protective cap from standard base and crimp on nonelectric blasting cap.

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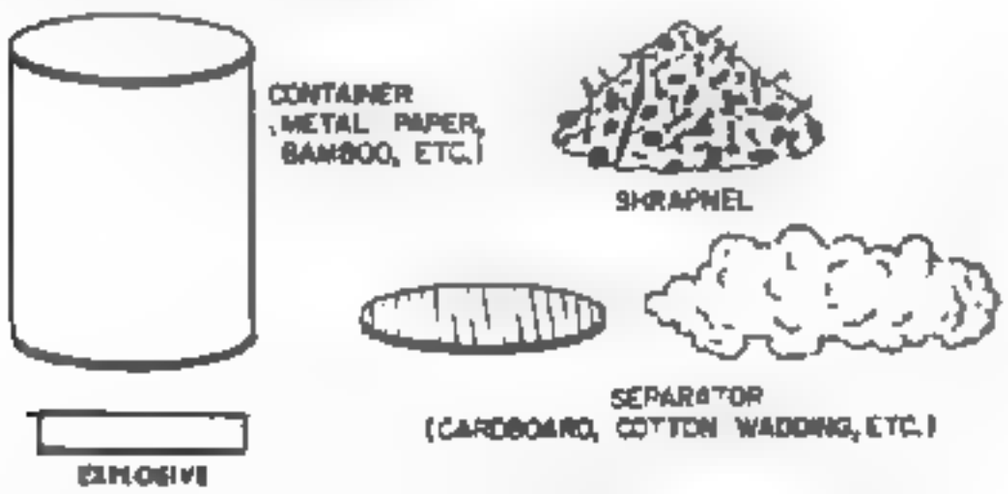
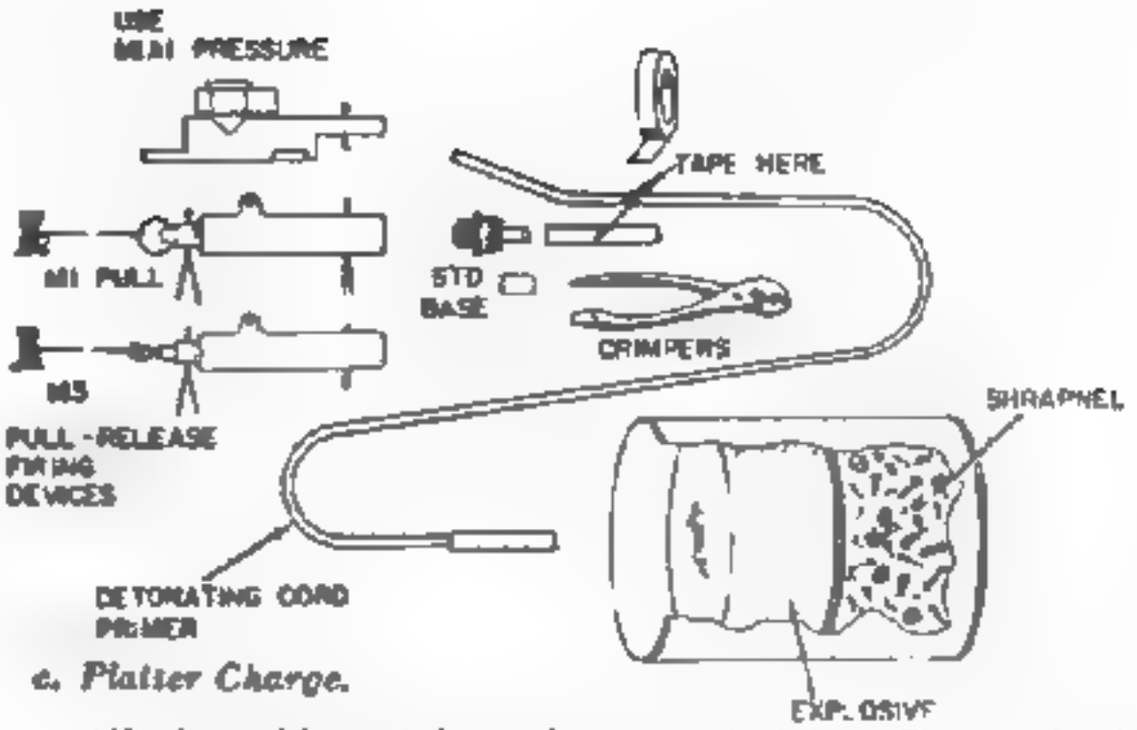
(3) Screw standard base with blasting cap into proper firing device.
(4) Secure firing device in place.
(5) Fix primer in rear center of explosive and tape to firing device.
(6) Arm firing device.





c. Platter Charge.

(1) Assemble container, charge, and platter. Charge should weigh same as platter.
(2) Place primer in rear center of charge.
(3) Align center of platter with center of target mass.
(4) Attach and arm firing device.

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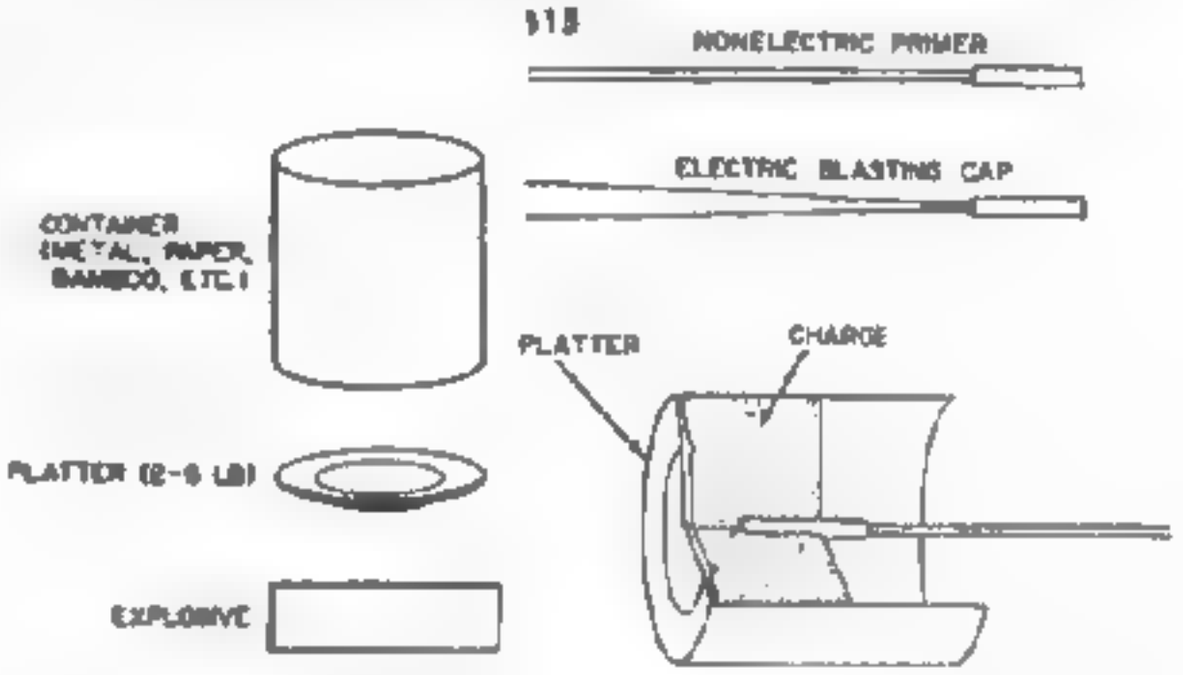
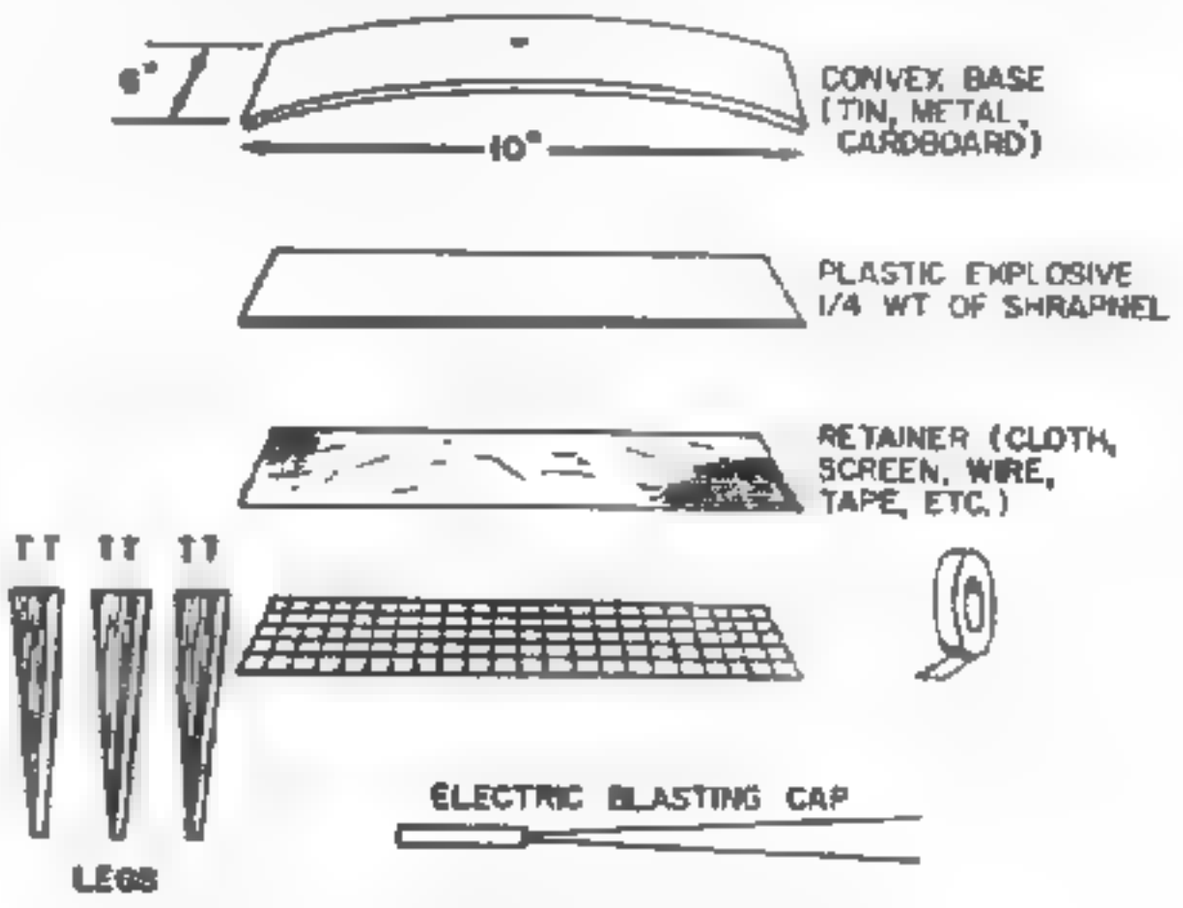


d. Improvised Claymore.

(1) Attach shrapnel to convex side of base and cover with cloth, tape, or screen retainer.
(2) Place layer of plastic explosive on concave side of base.
(3) Attach legs to concave side of base.
(4) Attach electric blasting cap at exact rear center.
(5) Attach firing device to firing wires at proper distance from mine for safety.



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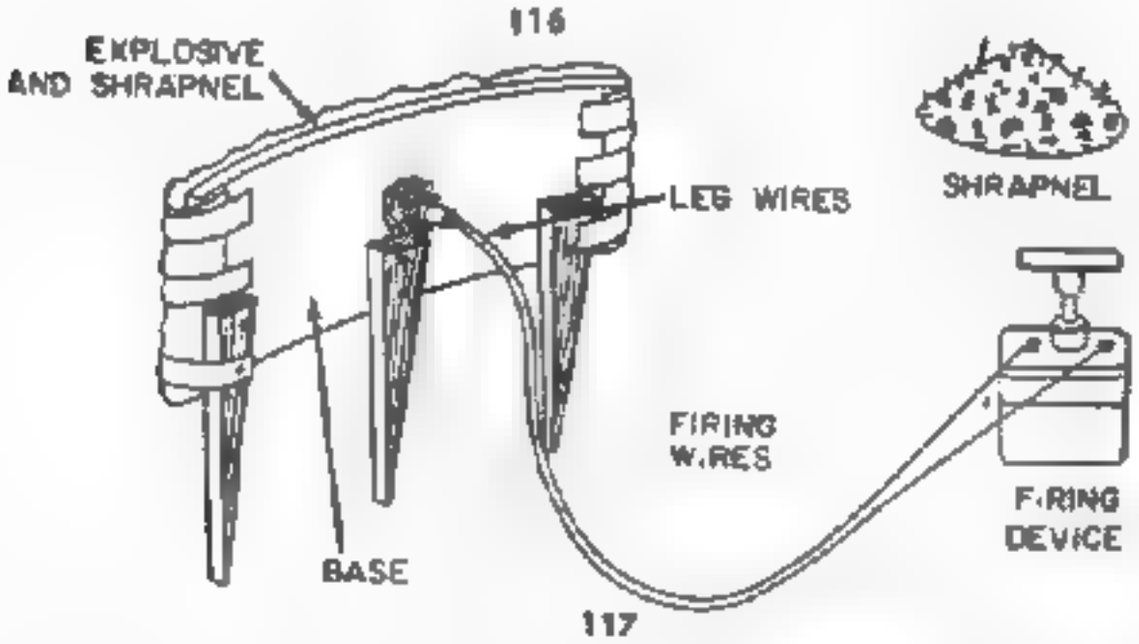

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CHAPTER 6
BOOBYTRAP DETECTION AND REMOVAL

Section I. CLEARING METHODS

63 Technicians

a. Although engineer and infantry specialists are responsible for boobytrap detection and removal, all military organizations assigned to combat zone missions must provide trained men to assist them.

b. If possible, trained engineer, infantry, or explosive ordnance disposal units will search out and neutralize all boobytraps in front of friendly troops or prepare safe passage lanes. When discovered, boobytraps will either be disarmed immediately or marked by warning signs. Only the simple ones will be disarmed during attack. Those more complicated will be marked and reported for removal.

c. To avoid casualty, boobytrapped areas, especially villages and other inhabited places, should be bypassed, to be cleared by specialists later. Tactical units will neutralize boobytraps only when necessary for continued movement or operation.

64. Clearance Teams

Men who clear boobytraps are organized into disposal teams and assigned to specific areas according to their training and experience.

a. Direction and control is the responsibility of the person in charge of clearance activities, who will—

(1) Maintain a control point near at hand and remain in close contact with his clearance parties.

(2) Give assistance to disposal teams when required.

(3) Preserve new types of enemy equipment found for more careful examination by engineer intelligence teams.

b. Searching parties will be sufficient in number to cover an area promptly, without interfering with each other.

c. In clearing a building, one person will direct all searching parties assigned.

d. Open area clearance will be preceded by reconnaissance if the presence of boobytraps is suspected. Once boobytraps are found, search must be thorough.

e. Searching parties must be rested frequently. A tired man, or one whose attention is attracted elsewhere, is a danger to himself and others working with him.

65 Tools and Equipment

a. Body Armor. Armor of various kinds is available. Special boots and shoe pacs, also issued, will give greater protection against blast than boots generally worn.

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b. Mine Detectors.

(1) Three mine detectors useful in the removal of boobytraps are issued: AN/PRS-3 (Polly Smith) and the transistorized, aural indication model, designed for metal detection, and AN/PRS-4 for nonmetallic detection. Of the metal detectors, the transistorized model is the lighter and more powerful. All three models have the same deficiences. They may signal a small piece of scrap as well as a metal-cased explosive or signal an air pocket in the soil, a root, or disturbed soil generally

(2) Operating time should not exceed 20 minutes to avoid operator fatigue. *Tired operators often become careless operators.*

c. Grapnels. These are hooks attached to a length of stout cord or wire, long enough for the operator to pull a mine or boobytrap from place from a safe distance or from at least 50 meters behind cover

d. Probes. Lengths of metal rod or stiff wire, or bayonets, are good probes for locating buried charges. Searching parties sometimes work with rolled-up sleeves better to feel trip wires and hidden objects.

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e. Markers. Standard markers are carried by disposal teams to designate the location of known boobytraps, pending their removal

f. Tape. Marking tape is useful for tracing safe routes and identifying dangerous areas

g. Hand Tools. Small items, such as nails, cotter pins, pieces of wire, friction tape, safety pins, pliers, pocket knife, hand mirror, scissors, flashlight, and screw driver are very useful in boobytrap clearance.

66. Detection

a. The most careful observation is required for the detection of boobytraps. Soldiers must be trained and disciplined to be on guard especially when moving over an area previously held by the enemy. Although a soldier may not be assigned the responsibility for their detection and clearance, he must be alert for any sign that may indicate their presence. He must also discipline himself to look carefully for concealed boobytraps before performing many acts of normal life.

b. Often prisoners of war through interrogation give information on new or unknown boobytrap devices that may aid in their identification and handling later on. Local inhabitants also often provide information on boobytraps laid in the neighborhood.

c. Searching for boobytraps and delayed charges is difficult and tedious, particularly when intelligence is lacking or inadequate. The extent of search required, the ease of placing and camouflag-

ing, and the great number of devices available to the enemy make the clearance of all charges almost impossible. Searching parties, before being sent out, will be briefed on all that is known about enemy activities in the area.

67. Outdoor Searching Techniques

As boobytraps are so deadly and as a rule cunningly conceived and hidden, outdoor searching parties should be suspicious of –

a. All moveable and apparently valuable and useful property

b. All disturbed ground and litter from explosive containers.

c. Marks intentionally left behind to attract or divert attention.

d. Evidence of former camouflage.

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e. Abrupt changes or breaks in the continuity of any object, such as unnatural appearances of fences, paint, vegetation, and dust.

f. Unnecessary things like nails, wire, or cord that may be part of a boobytrap.

g. Unusual marks that may be an enemy warning of danger.

h. All obstructions, for they are ideal spots for boobytraps. Search carefully before lifting a stone, moving a low hanging limb, or pushing aside a broken-down wheelbarrow.

i. Queer imprints or marks on a road, which may lead a curious person to danger.

j. Abandoned vehicles dugouts, wells, machinery, bridges, gullies, defiles, or abandoned stores. Also walk carefully in or around these as pressure-release devices are easily concealed under relatively small objects.

k. Areas in which boobytraps are not found immediately. Never assume without further investigation that entire areas are clear.

l. Obvious trip wires. The presence of one trip wire attached to an object does not mean that there are no others. Searching must be complete.

68. Indoor Searching Techniques

Those in charge of disposal teams should

a. Assign no more than one man to a room in a building.

b. Indicate the finding of a large charge by a prearranged signal. All teams except those responsible for neutralizing large charges must then vacate the building immediately by the original route of entry.

c. Examine both sides of a door before touching a knob. Observe through a window or break open a panel. If doors and windows must be opened and both sides cannot be examined, use a long rope.

d. Move carefully in all buildings, for boobytraps may be rigged to loose boards, moveable bricks, carpets, raised boards or stair treads, window locks or door knobs

e. Never move furniture, pictures, or similar objects before checking them carefully for release devices or pull wires.

f. Never open any box, cupboard door, or drawer without careful checking Sticky doors, drawers, or lids should be pulled with a long rope.

g. Not sit on any chair, sofa, or bed before careful examination.

h. Never connect broken wires or operate switches before checking the entire circuit Such action may connect power to a charge.

i. Remove all switch plates and trace all wires that appear foreign to a circuit. Examine all appliances.

j. Investigate all repaired areas. Look for arming holes. Enlarge all wall and floor punctures. Cavities may be examined by reflecting a flashLight beam off a hand mirror. (This is also applicable for searching under antitank mines.)

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k. Empty all fire boxes, remove the ashes, check fire wood, and move the coal pile.

l. Always work from the basement upward. Check, move, and mark everything movable including valves, taps, levers, controls, screens, and the like. A clockwork delay may not be heard if it is well hidden.

m. Double check basements and first floors—especially chimney flues, elevator and ventilator shafts, and insulated dead-air spaces. Check straight flues and shafts by observing from one end against a light held at the other Dog-leg flues may be checked by lowering a brick from a safe distance.

n. Guard all buildings until they are occupied

o. When possible and only after a thorough check, turn on all utilities from *outside* the building.

Note. A soldier by training can develop his sense of danger Also by experience and careful continuous observation of his surroundings while in a combat area, he can develop an acute instinct that warns him of danger—a most valuable asset toward self-protection.

Section II. DISARMING METHODS

69. Neutralization

a. This is the making of a dangerous boobytrap safe to handle If this is not possible, however, it must be destroyed. Neutralization involves two steps—*disarming* or replacing safeties in the firing assembly and *defuzing* or separating the firing assembly from the main charge and the detonator from the firing assembly

b. Although types of boobytraps found in conventional warfare in a combat zone vary greatly, equipment used by most armies is basically similar except in construction details. Accordingly, a knowledge of the mechanical details and techniques in the use of standard U.S. boobytrapping equipment in conventional warfare prepares a soldier to some extent for dealing with that of the enemy. This, however is not true in guerrilla warfare. Most enemy boobytraps found recently in guerrilla infested areas, were cunningly and ingeniously improvised and laid. Such boobytraps can rarely be neutralized even by the most experienced specialists. These are discussed and illustrated in chapter 5.

c. Boobytraps may be neutralized by two methods. (1) Whenever the location permits, they may be destroyed by actuating the mechanism from a safe distance or detonating a charge near the main charge These should be used at all times unless tactical conditions are unfavorable (2) When necessary, boobytraps may be disassembled by hand. As this is extremely dangerous, it should be

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undertaken only by experienced and extremely skillful specialists.

Note. Complete knowledge of the design of the boobytrap should be obtained before any neutralization is attempted.

d. In forward movements, all complicated mechanisms found are bypassed. These are marked and reported for neutralization later, when more deliberate action may be taken without harrassment by enemy fire.

e All boobytraps exposed to blast from artillery fire or aerial bombing should be destroyed in place.

f. Boobytraps with unrecognizable or complicated firing arrangements should be marked and left for specialists to disarm.

(1) Electrically fired boobytraps are among the most dangerous of all. Though rare in the past, they now turn up frequently in guerrilla warfare. Some may be identified by the presence of electric lead wires, dry cells, or other batteries. Some are small containers with all elements placed inside which actuate at the slightest disturbance. These can hardly be disarmed even by experts.

(2) Another difficult type has delay fuzing—a spring-wound or electric clockwork for long delay periods or chemical action firing devices. As the time of detonation is uncertain, such boobytraps should be destroyed in place. if possible or tactically fesasible.

70. Rules of Conduct

a. Keep in constant practice by inspecting and studying all known boobytrap methods and mechanisms

b. Develop patience. A careless act may destroy you and others as well

c. Remember that knowledge inspires confidence

d. Let only one man deal with a boobytrap Keep all others out of danger.

e. If in doubt, get help from an expert

f. Never group together when there is danger

g. Be suspicious of every unusual object.

h. Regardless of nationality, consider every enemy a ruthless, cunning and ingenious killer.

71. Detailed Operations

a. Destruction in Place.

(1) If damage is acceptable, which is generally the case out of doors the operator may initiate boobytrap riggings by their own mechanism or by a rope from a safe position (at least 50 meters away).

(2) The easiest method of getting rid of a boobytrap is to detonate a pound of high explosive adjacent to the main charge.

b. Removal of Main Charge (Antitank Mine).

Careful probing or search around the charge is necessary to locate and neutralize all antilift devices. Recognition of the type of firing mechanisms used is necessary to avoid casualty. All safety

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devices must be replaced. If complete neutralization seems doubtful the charge should be pulled from place by a grapnel or rope from a safe location. After the charge is pulled, the operator should wait at least 30 seconds as a safeguard against a concealed delay action fuze.

c. Hand Disarming. None but trained specialists should undertake this job, unless the boobytrap's characteristics and disarming techniques are well known. Trained specialists only should inspect and destroy all unusual or complicated mechanisms for safety reasons and for information on new enemy devices. The following procedures for hand neutralization are for guidance only, as the exact sequence depends on the type of device and the manner of placement.

(1) Do not touch any part of a boobytrap before examining it thoroughly. Locate all firing devices and their triggering mechanisms.

(2) When tracing wires, look for concealed intermediate devices laid to impede searching. Do not disturb any wires during the examination of the boobytrap.

(3) Cut loose trip wires only after careful examination of all connecting objects and their functions and replacing all safeties.

(4) Trace taut wires and disarm all connected firing devices by replacing safeties. Taut wires should be cut only when the danger at both ends has been eliminated.

(5)) Replace safeties in all mechanisms, using nails, lengths of of wire, cotter pins, and other objects.

(6) Never use force in disarming firing devices.

(7) Without disturbing the main charge, cut detonating cord or other leads between the disarmed firing devices and the main charge.

(8) Cut wires leading to an electric detonator *one at a time.*

(9) When using a probe, push it gently into the ground. *Stop* when you touch any object. It may be a pressure cap or plate.

(10) Once separated, boobytrap components should be removed to a safe storage or disposal area.

d. Special Precautions.

(1) Be very cautious in handling delay mechanisms. Although there may be little danger before the appointed time, auxiliary firing devices may be present. All complicated and confusing devices should be destroyed in place or marked for treatment by specialists.

(2) Explosive containers of wood or cardboard, buried for long periods are dangerous to disturb. They are also extremely dangerous to probe if in an advanced state of decomposition. Deteriorated high explosives are very susceptible to detonation. Thus destruction in place of a boobytrap and in a concentrated area long exposed to moisture may detonate many others simultaneously.

metal forms extremely sensitive salts readily detonated by handling.

(3) Metallic explosive containers, after prolonged burial, are often dangerous to remove. Oxidation may make them resistant to detection. After a time the explosive may become contaminated, increasing the danger in handling. Explosives containing picric acid are particularly dangerous as deterioration from contact with

(4) Fuzes of certain types become extremely sensitive to disturbance from exposure to wet soil. The only safe method of neutralizing or removing such deteriorated boobytraps is detonation in place.

72. Explosive Disposal

a. Usually, explosive items recovered by hand neutralization are destroyed by specially-trained explosive ordnance disposal units. Should untrained troops be required to do this, they should follow established procedures with great care. Explosives to be detonated should be buried in a pit at least 4 feet deep under 2 feet of earth, free of rocks or other matter that may become flying debris.

b. Components should be placed on their side or in position to expose their largest area to the force of the initiating explosive. Demolition blocks should be used for destruction of these components, if available but bangalore torpedoes or dynamite may be substituted. Primed charges should always be connected to firing mechanisms by detonating cord, so that blasting caps may be connected at the last minute. This eliminates opening the pit in the event of a misfire. All persons engaged in disposal should take cover when explosive components are detonated. Despite the 2-foot layer of earth, fragments may be thrown at high velocity for several hundred yards.

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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

UNCONVENTIONAL WARFARE DEVICES AND TECHNIQUES

INCENDIARIES

HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1966

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Unconventional Warfare Devices and Techniques

INCENDIARIES

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CHAPTER 1
INTRODUCTION

0001. INCENDIARY SYSTEMS

a. This manual covers all aspects of incendiary systems. It describes useful initiators, igniters, incendiary materials, delay mechanisms, and spontaneous combustion devices designed for direct use in sabotage and unconventional warfare.

b. Incendiaries are primarily used in sabotage to set fire to wooden structures and other combustible targets. Certain incendiaries, such as thermite, can be used for melting, cutting, or welding metals.

c. The most basic incendiary system consists of putting a lighted match to an easily combustible material. However, a simple match is not always effective. There are many important combustible targets that require far more heat for reliable ignition than is available from a match. There are also instances where delayed ignition is essential for sabotage success. This manual contains formulations and devices to satisfy the requirements for high ignition heat and predetermined ignition delay times for use in sabotage and other harassment actions.

d. Every incendiary system consists of a group of elements starting with an initiator and ending with the main incendiary material. If the initiator does not produce enough heat for reliable ignition of the combustible target, an intermediate or booster incendiary is required. More than one booster is necessary for some targets. The initiator (ch 2) can consist of a simple match, a match and a fuse cord, an acid, or water. The intermediate heat sources are generally called igniters (ch 3). Igniters produce sufficient heat to set the principal incendiary charge (ch 4) aflame. Delay mechanisms (ch 5) are frequently used to prevent detection of the saboteur by postponement of the fire for some limited, predetermined time after placement and actuation of the device.

e. Spontaneous combuston is a good sabotage tool. Favorable conditions can be established for the deliberate employment of spontaneous combustion (ch 6), that is, setting combustible material aflame without application of direct flame or spark.

f. All of the devices and techniques described herein have been thoroughly checked by independent test to

make certain that they work as intended. Detailed instructions are given for the necessary ingredients and their preparation. It is important that these instructions be followed carefully to be sure that the devices will operate properly. In addition, close attention to the instructions will assure safety.

0002. DEFINITIONS

Common terms used in connection with incendiary systems are defined below. Note that the definitions are worded so as to cover only incendiaries. Some of the terms have additional meanings in the related field of explosives.

a. Delay Mechanism. Chemical, electrical, or mechanical elements that provide a time delay. Elements may be used singly or in combination. They provide a predetermined, limited time interval before an incendiary starts to burn.

b. Fuse. A flexible fabric tube containing powder that is used to start fires at some remote location. The powder in the fuse burns and provides a time delay.

c. Igniter. An intermediate charge between an initiator and an incendiary material. It is set aflame by the initiator and produces sufficient heat at high temperature to ignite the main incendiary. Igniters are fast burning and relatively short lived.

d. Incendiary Material. A material that burns with a hot flame for long periods. Its purpose is to set fire to wooden structures and other combustible targets.

e. Incendiary System. A group of elements that are assembled to start fires. The system consists of initiator, delay mechanism (if needed), igniter, and incendiary material.

f. Initiator. The source that provides the first fire in an incendiary system. A match is an initiator. The initiator is so sensitive that it can be set off with little energy.

g. Spontaneous Combustion. The outbreak of fire in combustible material that occurs without an application of direct spark or flame. The fire is the result of heat produced by the chemical action of certain oils.

h. Thermite. An incendiary mixture of iron oxide flakes and aluminum powder that reacts chemically when initiated to form molten iron. Thermite can be used to burn holes in steel or to weld steel parts together.

0003. TOOLS AND TECHNIQUES

a. The equipment needed for the manufacture of incendiaries consists of simple items. They are all readily available. Required are bottles, jars, pots, and spoons. There should be no difficulty in obtaining any of them. All of the necessary equipment is described in each paragraph dealing with a particular incendiary component.

b. It is important that the operator follow the directions given in this manual *exactly* as written. They have been worked out carefully to give the desired results with the minimum chance of mishap. Don't experiment with different procedures or quantities.

c. By its very nature, the manufacture of incendiaries is dangerous. It is the function of incendiaries to burn with an intense flame under the right conditions. Care must be taken that no fires result during the making or placing of the devices. There are also other dangers in addition to the fire hazard. The chemicals used as ingredients may burn the skin, give off poisonous fumes, or be easily flammable. They must not be eaten.

d. When handled with care and proper precautions, incendiaries are fairly safe to make and use. Detailed precautions and instructions are given in each paragraph where they apply. General safety precautions follow:

Preventing a Fire Hazard

1. Fire prevention is much more important than fire fighting. Prevent fires from starting.
2. Keep flammable liquids away from open flames.
3. Good housekeeping is the fire prevention. Keep work areas neat and orderly. Clean away all equipment and material not needed at the moment. Clean up spills as soon as possible.
4. Store incendiaries in closed containers away from heat. Do not store material any longer than necessary.
5. In the event of fire, remove the incendiaries from the danger area if this can be done quickly and safely. Use large quantities of water to fight fires.
6. Horse play is dangerous and absolutely intolerable.

Avoiding Chemical Hazards

1. Wear rubber gloves, apron, and glasses when handling concentrated chemicals if at all possible.
2. Avoid inhaling fumes. Perform reactions in a well ventilated area or out of doors because the boiling is often violent and large amounts of fumes are given off that are poisonous if breathed too much.
3. Avoid acid contact with the skin. If chemicals are spilled on a person, wash immediately in running water for several minutes. If they splash in the eyes, wash the open eye in running water for at least 15 minutes.
4. Clean up any acid that is spilled on floor or bench by flushing with large amounts of water. Acid spilled

on wood can cause a fire.

5. Always pour concentrated acids into water. Never pour water into concentrated acids because a violent reaction will occur.

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CHAPTER 2

INITIATORS

0101. FUSE CORD

a. Description.

(1) This item consists of a continuous train of explosive or fastburning material enclosed in a flexible waterproof cord or cable. It is used for setting off an explosive or a combustible mixture of powders by action of the fuse flame on the material to be ignited. Fuse cord can be initiated by a match flame, using a specific procedure, or with a standard U.S. Army fuse lighter. Fuse cord burns at a uniform rate allowing the user to be away from the immediate scene when the incendiary actually functions.

(2) Fuse cord does not directly ignite any incendiaries listed in chapter 4 but is a primary initiator for all igniters listed in chapter 3 except: Potassium Permanganate—Glycer in (0206), Powdered Aluminum—Sulfur Pellets (0207), White Phosphorus (0209), and Sub-igniter For Thermite (0211).

b. Material and Equipment. Two Standard U.S. Army fuse cords are available:

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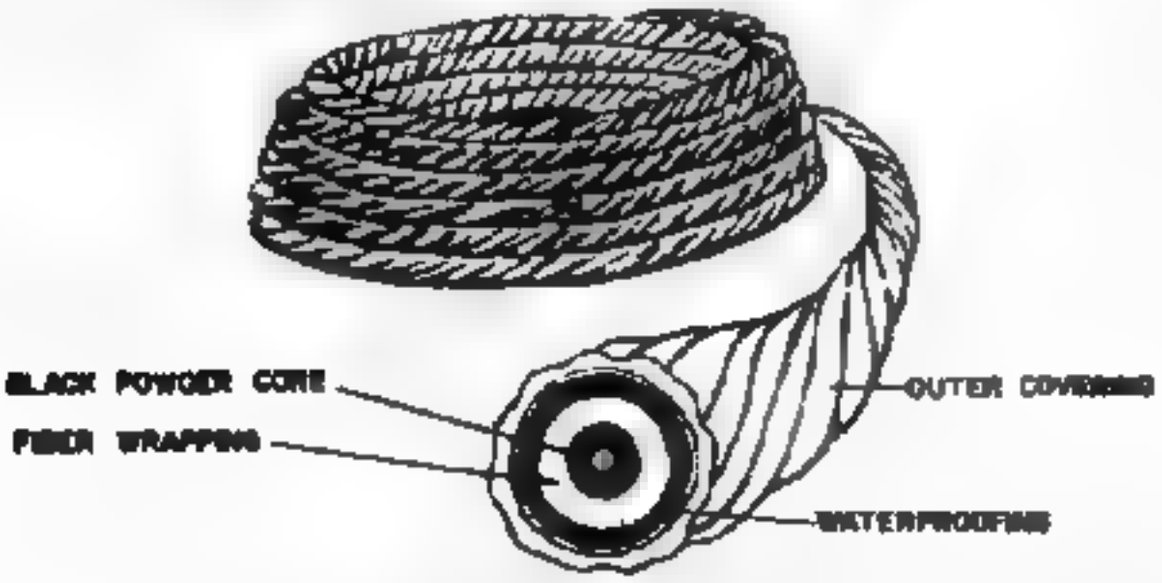
(1) *Blasting time fuse.*



This consists of black powder tightly wrapped with several layers of fabric and waterproofing materials. It might be any color, orange being the most common. The diameter of this fuse cord is 0.2 inch (a little larger than ⅕ inch). This fuse burns inside the wrapping at a rate of approximately 40 seconds per foot. It must be tested before use to verify the burning rate.

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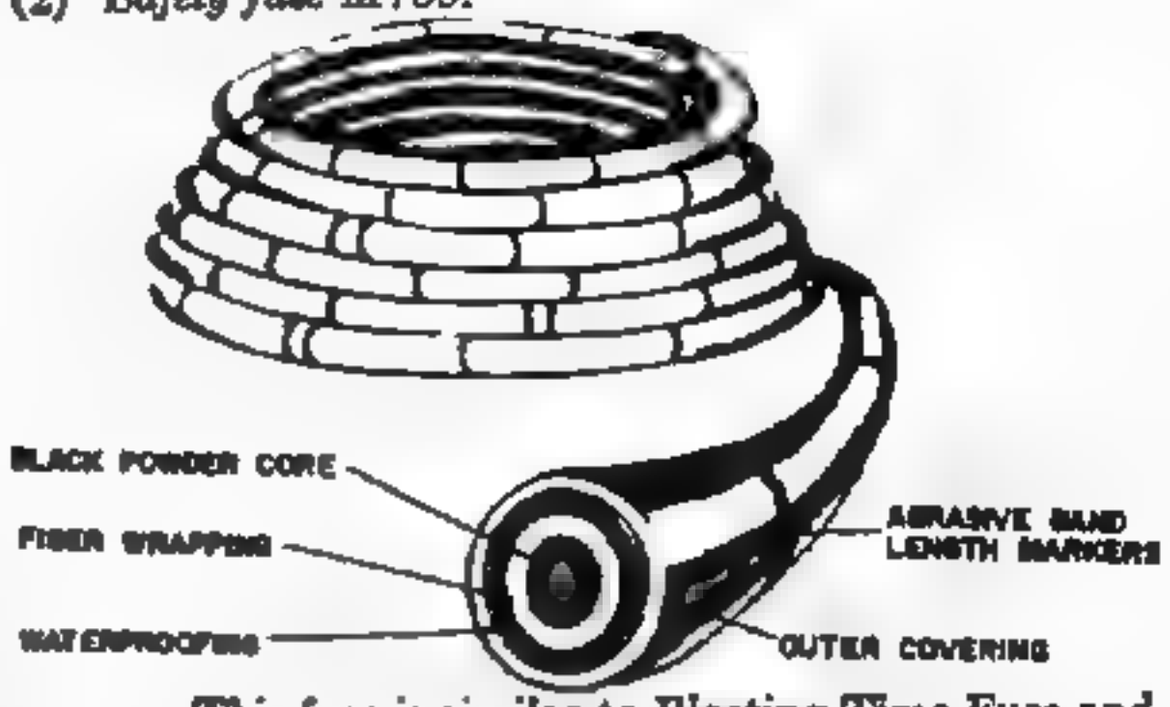
(2) *Safety fuse M700.*



This fuse is similar to Blasting Time Fuse and may be used interchangeably with it. The fuse is a dark green cord 0.2 inch in diameter with a plastic cover, either smooth or with single painted abrasive bands around the outside at 1 foot or 18 inch intervals and double painted abrasive bands at 5 foot or 90 inch intervals depending on the time of manufacture. These bands are provided to make measuring easy. They are abrasive so that they can be felt in the dark. The fuse burns inside the wrapping at a rate of approximately 40 seconds per foot. It must be tested before use to verify the burning rate.

Note. A commercial item can be substituted for either of the above U.S. Army issue items. The commercial fuse is 0.1 inch (about ⅛ inch) in diameter and is coated only with waterproofing lacquer. This fuse can be easily ignited by holding the free end in a match flame because the outside covering if flammable.

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c. Preparation. None.

d. Application.

(1) *General.*

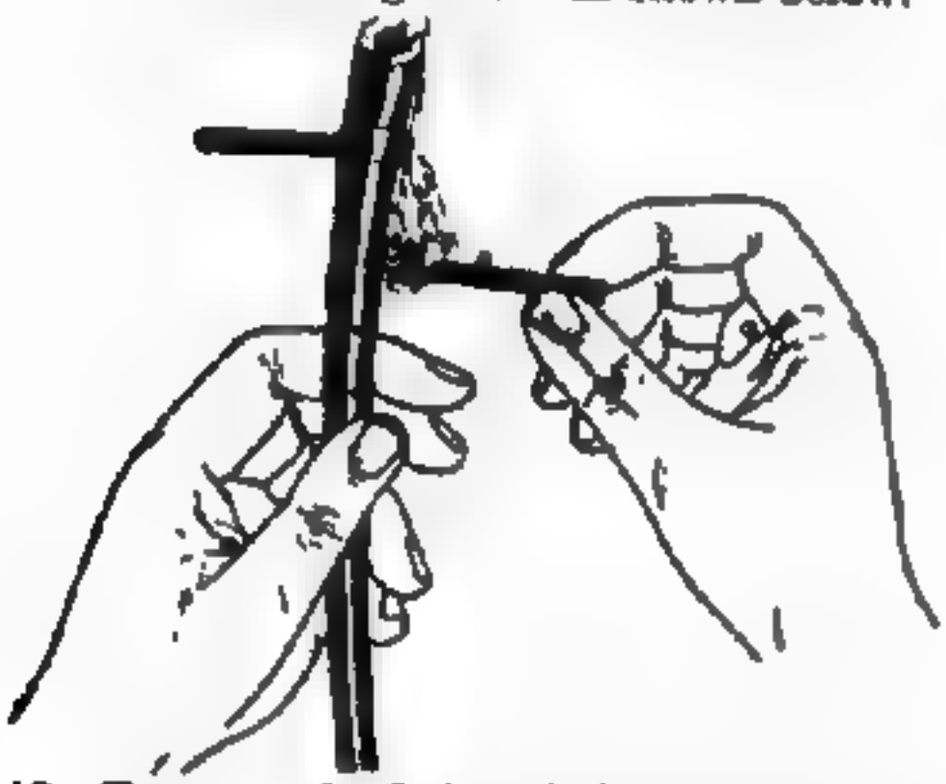
(a) Cut and discard a 6-inch length from the free end of the fuse roll. Do this to be sure that there is no chance of misfire from a damp powder train because of absorption of moisture from the open air. Then cut off a measured length of fuze to check the burning rate. Check the burning rate before actual use.

(b) Cut the fuse long enough to allow a reasonable time delay in initiation of the incendiary system. The cut should be made squarely across the fuse.

(c) Prepare the fuse for ignition by splitting the fuse at one end to a depth of about one inch. Place the head of an unlighted match in the powder train.

(*d*) Insert the other end of the fuse into a quantity of an igniter mixture so that the fuse end terminates near the center of the mixture. Be sure the fuse cord is anchored in the igniter mixture and cannot pull away. In the case of a solid igniter material such as Fire Fudge (0202), the fuse is split to about one-half inch at the end opposite the end containing the match in the powder train. This split fuse end is wedged over a sharp edge of the solid igniter material. Be sure the black powder in the fuse firmly contacts the solid igniter. If necessary, the fuse cord can be held firmly to the solid igniter with [redacted] light tape such as transparent adhesive tape.

(*e*) The fuse is initiated by lighting the match head inserted in the split end of the fuse with a burning match as shown below.



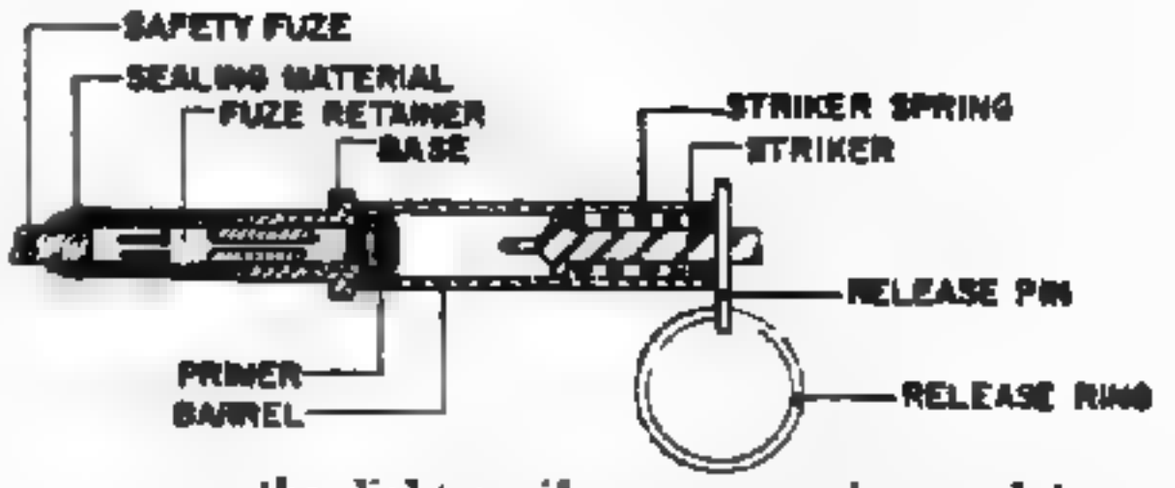
(*f*) Two standard fuse lighters, the M2 and M60, are available in demolition kits for positive lighting of Blasting Time Fuse and Safety Fuse M700 under all weather conditions—even under water if it is properly waterproofed. The devices are manually operated. A pull on the striker retaining pin causes the striker to hit the percussion primer, thus igniting the fuse. *These devices are not recommended where silence is required because a report is heard when the primer is fired.*

(2) *M2 fuse lighter.* [redacted]

The attachment and operation of the M2 Fuse Lighter are as follows:

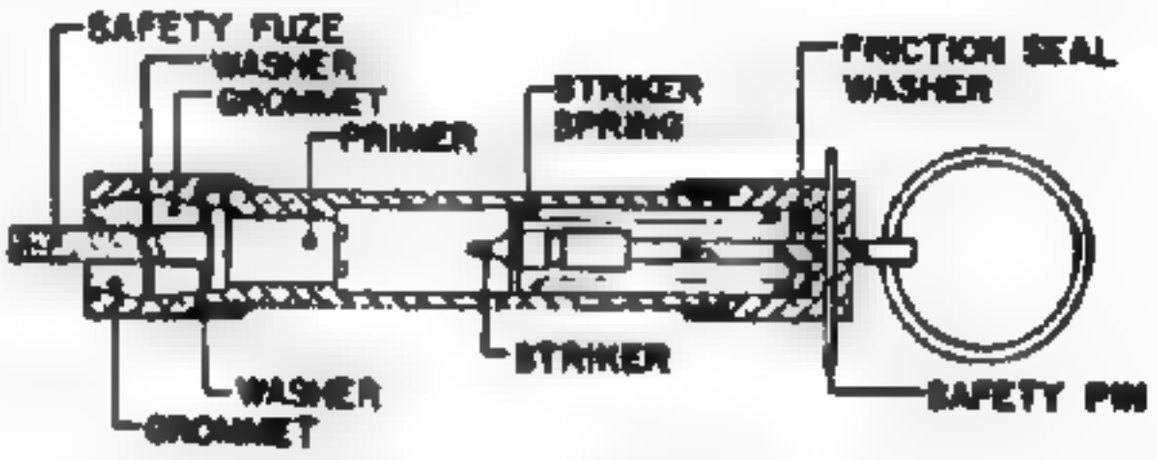
(*a*) Slide the pronged fuse retainer over the end of the fuse and firmly seat it.

(*b*) Waterproof the joint between the fuse and the lighter, if necessary, by applying a sealing compound (putty or mastic).



(*c*) In firing, hold the barrel in one hand and pull on the release pin with the other hand.

(3) *M60 fuse lighter.*



The attachment and operation of the M60 Fuse Lighter are as follows:

(*a*) Unscrew the fuse holder cap two or three turns.

(*b*) Press the shipping plug into the lighter to release the split grommet, and rotate the plug as it is removed.

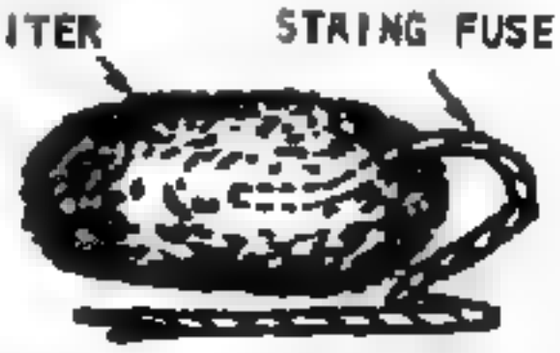
(*c*) Insert end of fuse in place of the plug until it rests against the primer.

(*d*) Tighten the fuse holder cap sufficiently to hold the fuse tightly in place and thus waterproof the joint.

(*e*) To fire, remove the safety pin, hold the barrel in one hand, and pull on the pull ring with the other hand.

[redacted]

a. Description.



(1) This item consists of string, twine, or shoelaces that have been treated with either a mixture of potassium nitrate and granulated sugar or potassium chlorate and granulated

sugar.

(2) Improvised string fuse does not directly ignite any incendiaries listed in chapter 4 but is a primary initiator for all igniters listed in chapter 3 except: Potassium Permanganate —Glycerin (0206), Powdered Aluminum— [redacted] Sulfur Pellets (0207), White Phosphorus (0209), and Subigniter For Thermite (0211).

(3) Depending upon the length of the fuse, the user can be away from the immediate scene when an incendiary system is initiated

b. Material and Equipment.

String, twine or shoelaces made of cotton or linen.
Potassium nitrate or potassium chlorate.
Granulated sugar.
Small cooking pot.
Spoon.
Heat source such as stove or hot plate.
Soap.

c. Preparation.

(1) Wash string or shoelaces in hot soapy water; rinse in fresh water.

(2) Dissolve one part potassium nitrate or potassium chlorate and one part granulated sugar in two parts hot water.

(3) Soak string or shoelaces in the hot solution for at least five minutes.

(4) Remove the string from hot solution and twist or braid three strands of string together.

(5) Hang the fuse up to dry.

(6) Check actual burning rate of the fuse by measuring the time it takes for a known length to burn.

d. Application.

(1) This fuse does not have a waterproof coating and it must be tested by burning a measured length before actual use.

(2) Cut the fuse long enough to allow a reasonable time delay in initiation of the incendiary system.

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(3) Insert one end of the fuse in a quantity of an igniter mixture so that the fuse end terminates near the center of the mixture. Be sure the fuse cord is anchored in the igniter mixture and cannot pull away. In the case of a solid igniter material such as Fire Fudge (0202), the improvised string fuse is securely wrapped around a piece of solid igniter material.

(4) The fuse is initiated by lighting the free end of the fuse with a match.

(5) This fuse does not burn when it is wet. Its use is not recommended where there is the possibility of the fuse getting wet.

0103. CONCENTRATED SULFURIC ACID (OIL OF VITRIOL)

a. Description.

(1) This material is a heavy, corrosive, oily, and colorless liquid. Storage is recommended in a glass container with a glass lid or stopper. Commercially available sulfuric acid is approximately 93 percent concentration with a specific gravity of 1.835. This is commonly referred to as concentrated sulfuric acid.

(2) Concentrated sulfuric acid chars wood, cotton, and vegetable fibers, usually without causing fire. The addition of water to concentrated sulfuric acid develops much heat which may be sufficient to cause a fire or an explosion. This depends upon the quantity of acid, quantity of water, and rate of addition of water.

Caution: Always add concentrated sulfuric acid to water. Never add water to a concentrated acid.

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(3) Certain igniter materials can be reliably brought to flaming by the addition of concentrated sulfuric acid This is brought about by the chemical reaction between the sulfuric acid and the igniter materials. The following igniters are initiated by concentrated sulfuric acid: Sugar-Chlorate (0201), Fire Fudge (0202), Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), Match Head (0205), and Silver Nitrate—Magnesium Powder (0208).

(4) The most important use for concentrated sulfuric acid as an initiator is in conjunction with delay mechaniams. The acid is held away from the igniter for a period of time by making use of the corrosive action of the acid to work its way through a barrier. If the delay mechanism is placed in a cold environment, the concentrated acid will remain fluid at extremely low temperatures. The following delay mechanisms are recommended for use with concentrated sulfuric acid Gelatin Capsule (0402), Rubber Diaphragm (0403), Paper Diaphragm (0404), Tipping Delay—Filled tube (0408), Tipping Delay—Balancing Stick (0410), and Stretched Rubber Band (0411).

b. Material and Equipment. Concentrated sulfuric acid.

c. Preparation. None—If only battery-grade sulfuric acid is available (specific gravity 1.200), it must be concentrated before use to a specific gravity of 1.835. This is done by heating it in an enameled, heat-resistant glass or porcelain pot until dense, white fumes appear. Heat only in a well ventilated area. When dense, white fumes start to appear, remove the heat and allow acid to cool. Store the concentrated acid in a glass container

d. Application.

(1) *General.* Commercial sulfuric acid is available in 13 gallon carboys. Smaller quantities of this acid are available in chemical laboratory reagent storage containers. It is recommended that a small quantity of acid, about one pint, be secured and stored in a glass container until it is used.

(2) *Use with delay mechanisms.*

(a) Construction of specific delay mechanisms is described in chapter 5. Within the delay mechanism, there is a container filled with acid. The acid corrodes this container, is absorbed by the container material or is spilled from the container until it comes in contact with the igniter mixture.

(b) Carefully fill the container in the delay mechanism with concentrated sulfuric acid. This can be accomplished easily with a small glass funnel. A medicine dropper is used when the delay mechanism container is small.

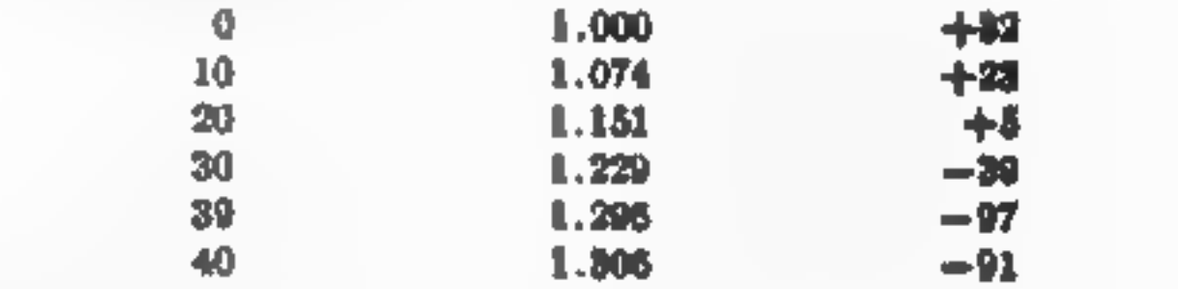
Caution: **Concentrated sulfuric acid must be handled carefully because it is very corrosive. If it is splashed on clothing, skin or eyes, the affected area must be immediately flushed with water. This may not be always practical. It is recommended that eye protection be worn by the user when pouring concentrated sulfuric acid. Many types are available for this purpose. Rubber gloves can be worn to protect the hands. A small bottle of water can be carried to flush small areas of skin or clothing which may be contaminated with the acid.**

(3) *Manual application.*

(a) Manual application of concentrated sulfuric acid for direct initiation of an igniter is not recommended when fuse cord is available. It is possible to employ this acid for direct initiation by quickly adding three or four drops to the igniter material. This can be accomplished with a medicine dropper. Keep hands and clothing clear of the igniter; ignition may take place almost instantly with addition of acid.

Caution: **Do not allow material such as sugar, wood, cotton or woolen fibers to fall into the *boiling acid*. A violent reaction could occur with splattering of acid.**

(b) Since sulfuric acid has a unique freezing point related to acid concentration, the information shown below is useful when this acid is used with delay mechanisms in low temperature surroundings. Be sure of acid concentration by checking with a hydrometer.



Sulfuric acid concentration (%)	Specific gravity	Freezing point (° F.)
0	1.000	+32
10	1.074	+23
20	1.151	+5
30	1.229	−30
39	1.296	−97
40	1.306	−91
50	1.406	−31
60	1.510	−22
70	1.611	−60
75	1.666	−7
77	1.706	+12
80	1.726	+27
81	1.747	+30
89	1.818	+24
90	1.824	+13
92	1.830	−1
93	1.835	−29

[illegible] WATER

a. Description.

(1) Water causes spontaneous initiation of certain igniter mixtures. This is caused by a chemical reaction of the igniter materials in the presence

of water. The following igniters are initiated by water: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), and Silver Nitrate—Magnesium Powder (0208).

(2) The most important use for water as an initiator is in conjunction with delay mechanisms. Since only a few igniter mixtures are initiated by water and *it cannot be used at freezing temperatures*, its use is limited. When tactics so dictate, water can be reliably used with the following delay mechanisms: Gelatin Capsule (0402), Overflow (0407), Tipping Delay—Filled Tube (0408), Balancing Stirk (0410), and Stretched Rubber Band (0411).

Note. Sulfuric acid of any concentration can be substituted for water in the initiation of water activated igniters. Water cannot be substituted for concentrated sulfuric acid.

b. Material and Equipment. Water.

c. Preparation. None.

d. Application.

(1) *Use with delay mechanisms.* Construction of specific delay mechanisms is presented in chapter 5. Within the delay mechanism, there is a container filled with water. The water dissolves the container or is spilled from the container and comes in contact with igniter mixture, initiating the fire train.

(2) *Manual application.* Fuse cord, when available, is recommended in preference to water as an initiator. Water is used for direct ignition of a specific igniter by adding drops as with a medicine dropper. Keep hands and clothing clear of the igniter; ignition may take place almost instantaneously with addition of water.

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CHAPTER 3

IGNITERS

0201 SUGAR-CHLORATE

a. Description.

(1) This item consists of a mixture of granulated sugar and potassium chlorate or sodium chlorate. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307) It may be used directly as an incendiary on readily flammable material such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101), Improvised String Fuse (0102), or Concentrated Sulfuric Acid (0103).

(3) This simple sugar-chlorate mixture closely resembles granulated sugar and should not ordinarily arouse suspicion. It is an excellent igniter.

***Caution:* This mixture is poisonous and must not be eaten.**

b. Material and Equipment.

Granulated sugar (do *not* use powdered or confectioners sugar.)

Potassium chlorate or sodium chlorate (no coarser than granulated sugar).

Spoon (preferably nonmetallic).

Container with tight-fitting lid.

Rolling pin or round stick.

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c. Preparation.

(1) Using a clean, dry spoon, place granulated sugar in the container to one-quarter container volume. Wipe the spoon with a clean cloth

(2) If the potassium or sodium chlorate is lumpy, remove all lumps by crushing with a rolling pin. Using the spoon, add an equal quantity of chlorate to the container.

***Caution:* If this mixture is carelessly handled with excessive bumping and scraping, it could be a fire hazard to the user. As a precaution, remove any mixture adhering to the lip or edge of the jar before tightening the lid.**

(3) Tighten the lid of the jar, turn the jar on its side and slowly roll until the two powders are completely mixed. The mixture is now ready for use. It may be stored for months in a tightly sealed container.

d. Application.

(1) Carefully pour or spoon the mixture, in a single pile, on the incendiary. Prepare the mixture for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the igniter mixture. Concentrated Sulfuric Acid (0103) can be used as an initiator, but is generally less convenient. Ignition takes place almost immediately on contact with the acid. Acid is recommended for use with specific delay mechanisms found in chapter 5.

(2) If only battery-grade sulfuric acid is available, it must be concentrated before use to a

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specific gravity of 1.835 by heating it in an enameled, heat-resistant glass or porcelain pot

until dense, white fumes start to appear. See paragraph 0103 for details.

(3) When used to ignite flammable liquids, wrap a quantity of the mixture in a nonabsorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(4) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0205 FIRE FUDGE

a. *Description.*

(1) This item consists of a mixture of sugar and potassium chlorate in a hot water solution which solidifies when cooled to room temperature. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307). It may be used directly as an incendiary on readily flammable material, such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101), Improvised String Fuse (0102), or Concentrated Sulfuric Acid (0103).

(3) Fire fudge resembles a white sugar fudge having a smooth, hard surface. The advantage of this igniter material over Sugar-Chlorate (0201), is its moldability. The procedure for preparation must be followed closely to obtain a smooth, uniform material with a hard surface

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Caution: **This material is poisonous and must not be eaten.**

b. *Material and Equipment.*

Granulated sugar (do *not* use powdered or confectioners sugar)

Potassium chlorate (no coarser than granulated sugar)

Metallic, glass or enameled pan.

Measuring container (size of this container determines quantity of finished product).

Spoon (preferably nonmetallic).

Thermometer (to read in the range 200° F. to 250° F.)

Heat source.

c. *Preparation.*

(1) Clean the pan by boiling some clean water in it for about five minutes. Discard the water, pour one measureful of clean water into the pan and warm it. Dry the measuring container and add one measureful of sugar. Stir the liquid until the sugar dissolves.

(2) Boil the solution until a fairly thick syrup is obtained.

(3) Remove the pan from the source of heat to a distance of at least six feet and shut off heat. Rapidly add two measurefuls of potassium chlorate. Stir gently for a minute to mix the syrup and powder, then pour or spoon the mixture into appropriate molds. If the mold is paper, it can usually be peeled off when the fire fudge cools and hardens. Pieces of cardboard or paper adhering to the igniter will not impair its use. Pyrex glass or ceramic molds can be used when a clear, smooth surface is desired. It is recommended that section thickness of molded fire fudge be at least one-half inch. If desired, molded fire fudge can be safely broken with the fingers.

(4) This material is moderately hard immediately after cooling. It will become harder after 24 hours. When kept in a tightly sealed container, it will retain its effectiveness for months.

Caution: **If this igniter material is carelessly handled with excessive bumping or scraping, it could be a fire hazard to the user.**

d. *Application.*

(1) Place a piece of fire fudge on top of the incendiary. Minimum size should be about one inch square and one-half inch thick. Prepare the fire fudge for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. Concentrated Sulfuric Acid (0103) can be used as an initiator but is generally less convenient. Acid is recommended for use with specific delay mechanisms found in chapter 5.

(2) If only battery-grade sulfuric acid is available, it must be concentrated before use to a specific gravity of 1.835 by heating it in an enameled, heat resistant glass or porcelain pot until dense, white fumes start to appear. See paragraph 0103 for details.

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(3) When used to ignite flammable liquids, wrap a quantity of the igniter mixture in a nonabsorbent material and suspend it inside the

container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(4) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0203. SUGAR—SODIUM PEROXIDE

a. *Description.*

(1) This item consists of a mixture of sodium peroxide and granulated sugar. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307). It may be used directly as an incendiary on readily flammable material such as rags, dry paper dry hay, or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101), Improvised String Fuse (0102), Concentrated Sulfuric Acid (0103), or Water (0104).

***Caution:* This mixture is unstable and can ignite at high humidity or when wet slightly by drops of water, perspiration, etc.**

b. *Material and Equipment.*

Granulated sugar (do *not* use powdered or confectioners sugar).

Sodium peroxide (no coarser than granulated sugar).

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Spoon.

Container with tight fitting lid for mixing and

[redacted]

c. *Preparation.*

(1) Using a clean, dry spoon, place granulated sugar in the container to one-quarter container volume.

(2) Wipe the spoon with a clean, dry cloth, and add an equal amount of sodium peroxide to the dry mixing container. Tighten the lid on the sodium peroxide container, and remove it at least six feet from the working area.

(3) Tighten the lid on the mixing container. Turn the container on its side and slowly roll until the two powders are completely mixed. The mixture is now ready for use.

(4) A good practice is to keep the granulated sugar and sodium peroxide in separate air-tight containers and mix just before use.

***Caution:* Do not store this mixture longer than three days because decomposition may occur and cause spontaneous combustion. Be sure that the storage container is air-tight.**

d. *Application.*

(1) Carefully pour or spoon the mixture, in a single pile, on the incendiary. Prepare the mixture for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the igniter mixture. Concentrated Sulfuric Acid (0103) and Water (0104) can be used as initiators, but are generally less convenient. Ignition takes place almost immediately on contact with the

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acid or water. These liquid initiators are convenient for use with specific delay mechanisms found in chapter 5.

(2) When used to ignite flammable liquids, wrap a quantity of the mixture in a non-absorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(3) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top of an open container of flammable liquid before lighting the fuse.

0204. ALUMINUM POWDER—SODIUM PEROXIDE

a. *Description.*

(1) This item consists of a mixture of sodium peroxide and powdered aluminum. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307). It may be used directly as an incendiary on readily flammable material, such as rags, dry paper, dry hay or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101), Improvised String Fuse (0102), Concentrated Sulfuric Acid (0103), or water (0104).

***Caution:* This mixture is unstable and can ignite at high humidity or when wet slightly by drops of water, perspiration, etc.**

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b. *Material and Equipment.*

Powdered aluminum (no coarser than granulated sugar).

Sodium peroxide (no coarser than granulated

sugar).
Spoon.
Container with tight fitting lid for mixing and storage.

c. *Preparation.*

(1) Using a clean, dry spoon, place powdered aluminum in the container to one-quarter container volume.

(2) Wipe the spoon with a clean, dry cloth, and add an equal amount of sodium peroxide to the dry mixing container. Tighten the lid on the sodium peroxide container, and remove it at least six feet from the working area.

(3) Tighten the lid of the mixing container. Turn the container on its side and slowly roll until the two powders are completely mixed. The mixture is now ready to use.

(4) A good practice is to keep the powdered aluminum and sodium peroxide in separate containers and mix just before use.

Caution: **Do not store this mixture longer than three days because decomposition may occur and cause spontaneous combustion. Be sure that the storage container is air-tight.**

d. *Application.*

(1) Carefully pour or spoon the mixture, in a single pile, on the incendiary. Prepare the mixture for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate

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near the center of the igniter mixture. Concentrated Sulfuric Acid (0103) and Water (0104) can be used as initiators, but are generally less convenient. Ignition takes place almost immediately on contact with the acid or water. These liquid initiators are convenient for use with specific delay mechanisms found in (chapter 5.)

(2) When used to ignite flammable liquids, wrap a quantity of the mixture in a nonabsorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(3) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0205. MATCH HEAD

a. *Description.*

(1) This item consists of a quantity of match heads, prepared by breaking the heads off their match sticks and grouping the match heads together to form the desired quantity of igniter. Any kind of friction match will do. It can be used to ignite the following incendiaries listed in chapter 4: Napalm (0301), Gelled Gasoline (exotic thickeners) (0302), Gelled Gasoline (improvised thickeners) (0303), Paraffin-Sawdust (0304), and Flammable Liquids (0308). It may be used directly

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as an incendiary on readily flammable material such as rags, dry paper, dry hay or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by a match flame, Fuse Cord (0101), Improvised String Fuse (0102), or Concentrated Sulfuric Acid (0103).

b. *Material and Equipment.*

Razor blade or knife.
Container with tight-fitting lid.
Matches, friction.

c. *Preparation.*

(1) Using a knife or razor blade, cut off the match heads.

(2) Prepare the desired quantity of igniter and store it in an airtight container until ready for use.

d. *Application.*

(1) Pour or spoon the match heads, in a single pile, on the incendiary. Prepare the match heads for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the match head pile. Concentrated Sulfuric Acid (0103) or a match flame can also be used as an initiator. Ignition takes place almost immediately on contact with the acid or the match flame. Acid is recommended for use with specific delay mechanisms found in chapter 5.

(2) If only battery-grade sulfuric acid is available, it must be concentrated before use to a specific gravity of 1.835 by heating it in an enameled, heat-resistant glass or porcelain

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pot until dense, white fumes start to appear. See paragraph 0103 for details.

(3) When used to ignite flammable liquids, wrap a quantity of the match heads in a nonabsorbent material and suspend it inside the container near the open top. The container

must remain open for easy ignition and combustion of the flammable liquid.

(4) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0206. POTASSIUM PERMANGANATE—GLYCERIN

a. Description.

(1) This item consists of a small pile of potassium permanganate crystals which are ignited by the chemical action of glycerin on the crystals. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307). It may be used directly as an incendiary on readily flammable material, such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.

(2) Ignition is accomplished by causing a few drops of glycerin to contact the potassium permanganate crystals. A hotter flame is produced when powdered magnesium or powdered aluminum is mixed with the the potassium permanganate crystals.

(3) Ignition time, after addition of the glycerin, increases as temperature decreases. This igniter is not reliable below 50° F.

b. Material and Equipment.

Potassium permanganate crystals (no coarser than granulated sugar).

Glycerin.

One small container with tight-fitting lid for the glycerin.

One larger container with tight-fitting lid for the potassium permanganate crystals

Powdered magnesium or powdered aluminum (no coarser than granulated sugar).

c. Preparation.

(1) Put some glycerin in the small container and cap tightly.

(2) Fill the larger container with potassium permanganate crystals and cap tightly.

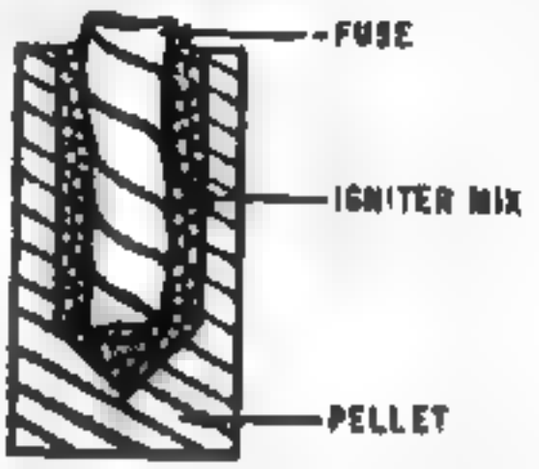
(3) If powdered magnesium or powdered aluminum is available, mix 85 parts potassium permanganate crystals and 15 parts powdered magnesium or powdered aluminum and store this mixture in the large bottle.

(4) Keep these containers tightly sealed and the material in the containers will remain effective for a long period of time.

d. Application. Pour out a quantity of the potassium permanganate crystals (with or without powdered aluminum or powdered magnesium), in a single pile on the incendiary. Manual ignition is accomplished by causing a few drops of glycerin from a medicine dropper to come in contact with the potassium permanganate crystals. Keep hands and clothing clear of the igniter; ignition may take place almost instantly with addition of the glycerin. This igniter is convenient for use with specific delay mechanisms found in chapter 5.

0207. POWDERED ALUMINUM—SULFUR PELLETS

a. Description.



(1) This igniter consists of finely powdered aluminum, sulfur and starch which have been thoroughly mixed and shaped into hardened cylindrical pellets. It can be used to ignite all the incendiaries listed in chapter 4. It is an excellent igniter for Thermite (0307). It may be used directly as an incendiary on readily flammable material such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101) or Improvised String Fuse (0102). A hole is made in one pellet to receive a fuse and a small quantity of another more easily started igniter mixture. A number of unmodified pellets are attached to the first pellet to increase the quantity of heat after combustion occurs.

b. Material and Equipment.

Finely powdered aluminum (no coarser than cake flour).

Finely powdered sulfur (no coarser than cake flour).

Finely powdered starch (no coarser than cake flour).

Water.

Cylindrical tube about 4 inches long and ¾ inch inside diameter made of metal, wood, glass or plastic.

Rod which fits into the above tube.

Rod about ⅜ inch in diameter (should be about

one-half the inside diameter of the 4-inch long tube).
Mixing bowl.
Tablespoon.
Teaspoon.
Stove or hot plate.
Knife.
Measuring container.

c. Preparation.

(1) Place six tablespoons of aluminum powder in a mixing bowl then add 15 tablespoons of powdered sulfur.
(2) Mix the two powders gently with the spoon for a few minutes until no unmixed particles of sulfur are visible.
(3) In a separate pot add two teaspoons of laundry starch to about 6 ounces of water and boil gently for a few minutes. Stir until the starch is dissolved and allow the solution to cool to room temperature.
(4) When cool, take about one-half of the starch solution and add it to the mixture of aluminum and sulfur powder.
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(5) Mix with a spoon until the whole mass is a smooth, evenly mixed, putty-like paste.
(6) Fill the cylindrical tube with this paste, place one end of this tube on a hard surface and tamp the paste with the 5/8 inch diameter rod to squeeze out the air bubbles and consolidate the paste.
(7) Push the paste out of the tube with the larger rod, which just fits the tube, so that it forms a cylinder, then cut the damp cylinder into 1½ inch lengths using the knife.
(8) Dry these pieces at 90° F. for at least 24 hours before using. The drying time can be reduced by using a drying oven at a maximum temperature of 150° F.
(9) Form a hole at least ½ inch in diameter approximately half-way into one end of an igniter pellet.
(10) Put one of the following igniters into the cavity to roughly one-half its depth:
Sugar-Chlorate (0201)
Sugar—Sodium Peroxide (0203)
Aluminum Powder—Sodium Peroxide (0204)
Silver Nitrate—Magnesium Powder (0208)
(11) Insert a length of fuse into the hole so that it makes contact with the igniter mix. Fill the remainder of the hole with igniter mix and tamp down to hold the fuse firmly.
(12) Tape the fuse cord in place to prevent it from working loose and falling out.
(13) Tape two or more pellets without holes to the one with the fuse.
(14) Store all the pellets in a dry, closed container until required for use.
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d. Application.

(1) For ignition of thermite, a cluster of at least three pellets should be used. Bury the cluster of igniter pellets just below the surface of the thermite, with the fuse extending for ignition by a match flame. Large quantities of thermite may require a cluster of more than three pellets for satisfactory ignition.
(2) For use as an igniter of a solid incendiary, place a cluster of pellets on top of the incendiary.
(3) When used to ignite flammable liquids, wrap a cluster of igniter pellets in a nonabsorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.
(4) To minimise the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0208. SILVER NITRATE—MAGNESIUM POWDER

a. Description.

(1) This item consists of a mixture of silver nitrate crystals and magnesium powder. It can be used to ignite all the incendiaries listed in chapter 4 except Thermite (0307). It may be used directly as an incendiary on readily flammable material such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.
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(2) The igniter can be initiated by Fuse Cord (0101), Improvised String Fuse (0102), Concentrated Sulfuric Acid (0103), or Water (0104).

Caution: **This mixture is unstable and may ignite at high humidity or when wet slightly by drops of water, perspiration, etc.**

b. Material and Equipment.

Silver nitrate crystals (no coarser than granulated sugar).
Magnesium powder or filings (no coarser than

granulated sugar).
Spoon.
Container with tight-fitting lid.

c. *Preparation.*

(1) Using a clean, dry spoon, place magnesium powder or filings into the dry mixing container to one-quarter container volume. If magnesium filings are used, they should be free of grease.

(2) Wipe the spoon with a clean, dry cloth, then add an equal quantity of silver nitrate crystals to the dry mixing container. Tighten the lid on the silver nitrate container, and remove it at least six feet from the working

[redacted]

(3) Tightly close the lid on the mixing container. Turn the container on its side and slowly roll until the two powders are completely mixed. The mixture is now ready for use.

(4) A good practice is to keep the silver nitrate crystals and the magnesium powder or filings in separate air-tight containers and mix just before use.

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Caution: **This mixture should be kept out of direct sunlight to avoid decomposition of the silver nitrate which could render this igniter mixture ineffective.**

d. *Application.*

(1) Carefully pour or spoon the mixture, in a single pile, on the incendiary. Prepare the mixture for ignition with either Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the igniter mixture. Concentrated Sulfuric Acid (0103) and Water (0104) can be used as initiators but are generally less convenient. Ignition takes place almost immediately on contact with the acid or water. These liquid initiators are convenient for use with specific delay mechanisms found in chapter 5.

(2) When used to ignite flammable liquids, wrap a quantity of the mixture in a nonabsorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(3) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0209. WHITE PHOSPHORUS

a. *Description.*

(1) This item consists of white phosphorus dissolved in carbon disulfide. It can be used to

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ignite the following incendiaries listed in chapter 4: Napalm (0301), Gelled Gasoline (exotic thickeners) (0302), Gelled Gasoline (improvised thickeners) (0303), and Paraffin-Sawdust (0304). It may be used directly as an incendiary on readily flammable material such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels

(2) Ignition is achieved when the volatile solvent, carbon disulfide, evaporates and the white phosphorus comes in contact with air.

Caution: **Never touch white phosphorus directly or allow any of its solutions to touch the skin. Painful burns which heal very slowly may result. White phosphorus sticks must *always* be stored completely under water. If any of the phosphorus solution is accidently spilled on the skin, immediately flush the affected area with water; then decontaminate the affected area by dabbing with copper sulfate solution.**

b. *Material and Equipment.*

White phosphorus sticks (sometimes called yellow phosphorus).
Carbon disulfide.
Copper sulfate solution
Tweezers or tongs.
Two glass containers about 8-ounce capacity with lids or stoppers made of glass, earthenware, or metal. Do not use a rubber lid or stopper (carbon disulfide will attack rubber).

c. *Preparation.*

(1) Prepare some copper sulfate solution by adding one spoonful of copper sulfate crystals

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to one of the glass containers. Fill the container with water, place the stopper in the open mouth of the bottle and shake until the crystals dissolve.

(2) Pour carbon disulfide into the other glass container to one-quarter container volume

Caution: **Carbon disulfide fumes are poisonous. Always cap an open container of carbon disulfide as soon as possible. Work in a well ventilated area.**

(3) With a pair of tweezers remove some sticks of white phosphorus from their storage container.

Totally submerge them immediately in the carbon disulfide to bring the level up to one-half full. Be sure that all the phosphorus left in the original container is completely submerged in water before putting the container away. Wash the tweezers immediately in the copper sulfate solution.

(4) Securely stopper the bottle containing the white phosphorus and carbon disulfide and allow to stand until the white phosphorus dissolves. This usually takes about eight hours. The time required to dissolve white phosphorus can be reduced by shaking the bottle. Be sure that the bottle top does not come off.

(5) Do not store in direct sunlight because the solution will become ineffective. This solution should never be stored more than three days.

Note. If carbon disulfide is not available, benzene (benzol) may be used to dissolve the phosphorus. It requires considerable shaking and overnight soaking to get an appreciable amount of phosphorus dissolved in benzene. Do not attempt to use red phosphorus for preparing this igniter because it does not behave like white phosphorus.

d. Application.

(1) To ignite readily flammable material, pour the white phosphorus solution directly onto the material; it will ignite when the solvent evaporates, exposing the white phosphorus to the air. Once the solution is poured, the empty bottle should be discarded immediately because any solution remaining on the bottle will ignite when the solvent evaporates. Do not cover the soaked flammable material because the carbon disulfide must evaporate for ignition to occur.

(2) The incendiaries mentioned under *Description* above can be initiated by first impregnating crumpled paper or absorbent paper towels with the white phosphorus solution and placing the impregnated paper on the material to be ignited.

(3) Delay times of the phosphorus solution may be varied by the addition of gasoline or toluene (toluol). Add a small quantity of either solvent to the original white phosphorus solution and test the solution each time until the desired delay time is achieved. Delay times of 20 to 30 minutes may be obtained in this manner.

(4) Check the delay time under conditions expected at the target. Air currents hasten the evaporation of the solvent and decrease delay time. A high ambient temperature will also decrease delay time whereas a low ambient temperature will increase the delay time. This igniter is not reliable at or below freezing temperatures (32° F.)

(5) To make incendiary paper, soak strips of ordinary writing paper in the phosphorus-carbon disulfide for a few minutes. Remove the paper with a pair of tweezers or tongs and place in a vial filled with water. Be sure to wash off the tweezers immediately in copper sulfide solution. Cap the vial and store until ready to use. To use this incendiary paper, remove the strips of paper with a pair of tweezers, and place among the material to be ignited.

0210. MAGNESIUM POWDER—BARIUM PEROXIDE

a. Description.

(1) This item consists of a mixture of finely powdered magnesium and finely powdered barium peroxide. It can be used to ignite all the incendiaries listed in chapter 4 and is particularly suited for ignition of thermite. It may be used directly as an incendiary on readily flammable material such as rags, dry paper, dry hay, or in the combustible vapor above liquid fuels.

(2) The igniter can be initiated by Fuse Cord (0101) or Improvised String Fuse (0102).

b. Material and Equipment.

Magnesium powder (no coarser than table salt).
Barium peroxide (no coarser than table salt).
Spoon.
Container with tight-fitting lid.

c. Preparation.

(1) Using a clean, dry spoon, place powdered magnesium into the dry mixing container to one-quarter container volume.

(2) Wipe the spoon with a clean, dry cloth, then add powdered barium peroxide to the dry mixing container to three-quarters container volume. Tighten the lid on the barium peroxide container, and remove it at least six feet from the working area.

(3) Tightly close the lid on the mixing container. Turn the container on its side and slowly roll until the two powders are completely mixed. The mixture is now ready for use.

(4) A good practice is to keep the powdered magnesium and powdered barium peroxide in separate containers and mix just before use.

d. Application.

(1) Carefully pour or spoon the mixture, in a single pile, onto the incendiary. Prepare the mixture for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the igniter mixture.

(2) In ignition of thermite, spread the igniter mixture to a depth of at least ¼ inch on the top surface of the thermite which is held in an assembly described under *Application* of Thermite incendiary (0307). The fuse cord will initiate the thermite igniter which will, in turn, ignite the thermite.

(3) When used to ignite flammable liquids, wrap a quantity of the mixture in a nonabsorbent material and suspend it inside the container near the open top. The container must remain open for easy ignition and combustion of the flammable liquid.

(4) To minimize the hazard of premature ignition of flammable liquid vapors, allow at least two feet of fuse length to extend from the top edge of an open container of flammable liquid before lighting the fuse.

0211. SUBIGNITER FOR THERMITE

a. Description.

(1) This item consists of a mixture of a metal powder and an oxidizing agent. Two metal powder alternates and four oxidizing agent alternates are specified. In the combustion process, the metal powder is oxidized, resulting in the liberation of a large quantity of heat.

(2) This subigniter is a substitute for Magnesium Powder—Barium Peroxide Igniter (0210), and should be used only if that Igniter is not available. The disadvantage of this subigniter is that it cannot be directly initiated by fuse cord. To use this subigniter for initiating thermite, it is necessary to use another igniter mixture to initiate the subigniter, preferably Sugar-Chlorate (0201). The fuse cord will initiate the sugar-chlorate, which will, in turn, ignite the subigniter and, thereby, initiate the thermite.

(3) This subigniter can be directly initiated by all the igniters listed in chapter 3 except White Phosphorus (0209).

b. Material and Equipment.

Either aluminum or magnesium filings or powder (no coarser than granulated sugar).

Any one of the following oxidizing agents sodium dichromate, potassium permanganate, potassium nitrate, or potassium dichromate (no coarser than granulated sugar).

Container with tight-fitting lid.

c. Preparation.

(1) Using a clean, dry spoon, place one of the metal powders or filings in the container to one-third container volume. If metal filings are used, they should be free of grease.

(2) Wipe the spoon with a clean, dry cloth and add an equal quantity of one of the above oxidizing agents.

(3) Tighten the lid on the mixing container, turn the container on its side and slowly roll until the two powders are completely mixed. The mixture is now ready to use and may be stored for months in this tightly sealed container.

d. Application.

(1) To use this subigniter, spread the material to a depth of at least ¼ inch on the top surface of the thermite which is held in an assembly described under *Application* of Thermite Incendiary (0307). Spread another igniter, preferably Sugar-Chlorate (0201) on top of this subigniter to about the same depth. Prepare the mixture for ignition with Fuse Cord (0101) or Improvised String Fuse (0102) in the normal manner. The fuse cord should terminate near the center of the igniter mixture. The fuse cord initiates the sugar-chlorate igniter which ignites the thermite subigniter which then ignites the thermite

(2) For delay times longer than those conveniently obtained with fuse cord in ignition of thermite by this subigniter method, refer to chapter 5.

***Caution:* Never attempt to ignite thermite subigniter without at least a few seconds delay fuse. It burns extremely fast and hot, and the user could be seriously burned if he were too close when ignition occurred.**

CHAPTER 4

INCENDIARY MATERIALS

0301. NAPALM

a. Description.

(1) This item consists of a liquid fuel which is gelled by the addition of soap powder or soap chips. It is easily prepared from readily available materials.

(2) This incendiary can be directly initiated by a match flame. However, if delay is required, the incendiary can be reliably initiated by a delay system consisting of any igniter listed in chapter 3 coupled with a delay mechanisms found in chapter 5.

(3) Napalm incendiary is easily ignited and long burning, and is suitable for setting fire to large wooden structures and other large combustible targets. It adheres to objects, even on vertical surfaces.

b. Material and Equipment.

Soap powder or chips (bar soap can be easily shaved or chipped). Detergents *cannot* be used.

Any of the following liquid hydrocarbon fuels: gasoline, fuel oil, diesel oil, kerosene, turpentine, benzol or benzene, toloul or toluene.

A double boiler made from any material with the upper pot having a capacity of at least two quarts.

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A spoon or stick for stirring.

A source of heat such as a stove or hot plate.

A knife or grater if only bar soap is available.

An air-tight container.

c. Preparation

(1) Fill bottom of double boiler with water and heat until the water boils. Shut off source of heat.

(2) Place upper pot on top of bottom pot and remove both containers to a point several feet from the heat source.

(3) Pour soap chips or powder into the upper pot of the double boiler to one-quarter of pot volume.

(4) Pour any one of the liquid hydrocarbon fuels listed under *Material and Equipment* above into the upper pot containing the soap chips or powder until the pot is one-half full.

***Caution:* Keep these fuels away from open flames.**

(5) Stir the mixture with a stick or spoon until it thickens to a paste having the consistency of jam. Do this in a well ventilated room where the vapors will not concentrate and burn or explode from a flame or spark.

(6) If the mixture has not thickened enough after about 15 minutes of stirring, remove the upper pot and put it several feet from the heat source. Again bring the water in the lower pot to a boil. Shut off heat source, place upper pot in lower pot at a location several feet from the heat source and repeat stirring until the napalm reaches the recommended consistency.

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(7) When the proper consistency is obtained, store the finished napalm in a tightly sealed container until used. Napalm will keep for months when stored this way.

d. Application.

(1) To use napalm most effectively, it should be spread out over the surface of the material to be burned. This will start a large area burning at once. A match can be used to directly initiate this incendiary. A short time delay in ignition can be obtained by combining Fuse Cord (0101) or Improvised String Fuse (0102) and one of the igniter mixtures found in chapter 3. (For example, several spoonfuls of Sugar-Chlorate mixture (0201) are placed in a nonabsorbent wrapping material. Fuse cord is buried in the center of the igniter mixture and the fuse is taped to the wrapping material. This assembly is placed directly on the napalm. Delay times are determined by the length of fuse. Suitable delay mechanisms are given in chapter 5 for delay times longer than those practical with fuse cord.)

(2) Napalm made with the more volatile fuels should not ordinarily be used with a delay longer than one hour because the liquid fuel evaporates and this can reduce its effectiveness. In very hot weather, or if the napalm is exposed to the direct rays of the sun, it is recommended that napalm be made with fuel oil. In extremely cold weather, it is recommended that napalm be made with gasoline.

(3) The destructive effect of napalm is increased when charcoal is added. The charcoal will

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readily ignite and the persistent fire from the charcoal will outlast the burning napalm. It is recommended that at least one quart of napalm be used to ignite heavy wooden structures and large wooden sections A minimum of one-half quart is recommended for wooden structures of small cross section.

0302. GELLED GASOLINE (EXOTIC THICKENERS)

a. Description.

(1) This item consists of gasoline which is gelled with small quantities of organic chemicals. The operation is carried out quickly, without heat, by addition of the chemicals while stirring.

(2) This incendiary can be directly initiated by a match flame. However, any igniter listed in chapter 3 can be used in conjunction with specific delay mechanisms found in chapter 5 for delayed ignition of this incendiary.

(3) Gelled gasoline incendiary is readily ignited, long burning, and is suitable for setting fire to large wooden structures and other large combustible targets. It adheres to objects, even on vertical surfaces.

b. Material and Equipment.

Gasoline.
Balance or scale.
Spoon or stick for stirring.
Large air-tight container.
Small jar.

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One of the following seven additive systems:

Components	Grams added per gal gas	Trade name	Manufacturer
SYSTEM 1			
A.. Lauryl amine..	55..	Alamine 4D Formonyte 616 Armeen.	General Mills Foremost Chemical Armour Chemical.
B.. Toluene diisocyanate.	27..	Hylene TM-65 Naeconate 65.	DuPont National Aniline.
SYSTEM 2			
A.. Coco amine.....	55..	Alamine 21 Formonyte 601.	General Mills Foremost Chemical.
B.. Toluene diisocyanate.	27..	Hylene TM-65 Naeconate 65.	DuPont National Aniline.
SYSTEM 3			
A.. Lauryl amine..	57..	Alamine 4D Formonyte 616 Armeen.	General Mills Foremost Chemical Armour Chemical.
B.. Hexamethylene diisocyanate.	25..	Hexamethylene diisocyanate.	Borden Chemical
SYSTEM 4			
A.. Oleyl amine.....	59..	Alamine II Formonyte 608.	General Mills Foremost Chemical.
B.. Hexamethylene diisocyanate.	23..	Hexamethylene diisocyanate.	Borden Chemical
SYSTEM 5			
A.. t-Octyl amine .	51..	t-Octyl.....	Rohm and Haas
B . Toluene diisocyanate.	31..	Hylene TM 65 Naconate 65.	DuPont National Aniline.

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Components	Grams added per gal gas	Trade name	Manufacturer
SYSTEM 6			
A.. Coco amine.....	51..	Alamine 21 Formonyte 601.	General Mills Foremost Chemical.
B.. Naphthyl isocyanate.	31..	Naphthyl isocyanate.	Distillation Products Industry.
SYSTEM 7			
A.. Delta-aminobutylmethyldiethoxysilane.	51..	Delta silane....	Union Carbide
B.. Hexamethylene diisocyanate.	31..	Hexamethylene diisocyanate.	Borden Chemical

c. Preparation.

(1) Determine the amount of gasoline to be gelled and place this amount in the large container.

***Caution:* Keep this material away from open flames.**

(2) Weigh out the appropriate quantity of component A. This can be calculated by multiplying the number of gallons of gasoline by the figure given in the *Grams Added Per Gal. Gas.* column of systems. (For example, if System 1 is being used and five gallons of gasoline are being gelled, then (5×55) or 275 grams of Lauryl amine are required).

(3) Add component A to the gasoline and stir for a few minutes to dissolve.

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***Caution:* Both components A and B are corrosive to the skin. If any of these materials contact the skin, wash the area with detergent and water.**

(4) Clean the small container used to weight component A thoroughly or use another container for weighing component B. Weigh out the proper quantity of component B. Calculate the proper amount as mentioned above for component A.

(5) Stir the gasoline—component A mixture rapidly and add all of component B at once, not a little at a time. At the same time that component B enters the mixture, remove the stirring rod and allow a few minutes for the gelling to take place.

(6) Store the gelled gasoline in a tightly sealed container until ready to use. It will keep for months when stored in this manner.

d. Application.

(1) To use gelled gasoline most effectively, it should be spread out over the surface of the material to be burned. This will start a large area burning at once. A match can be used to directly initiate this incendiary. A short time delay in ignition can be obtained by combining Fuse Cord (0101), or Improvised String Fuse (0102) and one of the igniter mixtures found in chapter 3. (For example, several spoonfuls of Sugar-Chlorate Mixture (0201) are placed in a nonabsorbent wrapping material. Fuse cord is buried in the center of the igniter mixture and the fuse is taped to the wrapping material. This assembly is placed directly on the gelled

[redacted]

gasoline. Delay times are determined by the length of fuse. Suitable delay mechanisms are given in chapter 5 for delay times longer than those practical with fuse cord.)

(2) Gelled gasoline should not ordinarily be used with a delay longer than one hour because gasoline evaporates and this can reduce its effectiveness.

(3) The destructive effect of gelled gasoline is increased when charcoal is added. The charcoal will readily ignite and the persistent fire from the charcoal will outlast the burning gasoline. It is recommended that at least one quart of gelled gasoline be used to ignite heavy wooden structures and large wooden sections. A minimum of one-half quart is recommended for wooden structures of small cross section.

Note. All of the chemicals used for the gelling process *must* be added in a *liquid* state. Many of the chemicals solidify at near freezing temperatures (32° F.) and uniform gels are difficult to produce at these temperatures.

0303. GELLED GASOLINE (IMPROVISED THICKENERS)

0303.1 LYE SYSTEMS

(1) This item consists of gasoline which is gelled by the addition of certain ingredients that are locally available. The following eight basic systems will produce gelled gasoline and are easily prepared: Lye systems, Lye-alcohol systems, Lye-balsam systems, Soap-alcohol systems, Egg system, Latex system, Wax systems, and Animal blood systems. These systems are discussed in the subparagraphs under 0303.

[redacted]

(2) These incendiaries can be directly initiated by a match flame. However, any igniter listed in chapter 3 can be used in conjunction with specific delay mechanisms given in chapter 5 for delayed ignition.

(3) Gelled gasoline incendiary is readily ignited, long burning and is suitable for setting fire to large wooden structures and other large combustible targets. It adheres to objects, even on vertical surfaces.

b. Material and Equipment.

Ingredient	*Parts by volume*	*Used for*	*Common source*
Gasoline..	60.....	Motor fuel.....	Gas stations or motor vehicles.
Lye.....	2 (flake) or 1 (powder).	Drain cleaner, making of soap, etc.	Food and drug stores, soap factories.
Water....	1 or 2....	(Always use about same amount as dry lye).	
Rosin powder.	15.....	Paint or varnish, Naval supply, industrial uses.	Food and drug stores, pine tree extract, paint and varnish factories.

Two air-tight containers
Spoon or stick for stirring

Note. Lye is also known as caustic soda or sodium hydroxide. Allow for strength of lye; if only 50% (as in Drano), use twice the amount indicated above. Castor oil can be substituted for the rosin. Potassium hydroxide (caustic potash, potassa) may be used in place of lye.

c. Preparation.

(1) Measure the required quantity of gasoline and place in a clean container.

[redacted]

Caution: Keep material away from open [redacted]

(2) Break the rosin into *small* pieces and add to the gasoline.

(3) Stir the mixture for about five minutes to disperse the rosin.

(4) In a separate container dissolve the lye in water.

Caution: Add lye to water slowly. Do not prepare this solution in an aluminum con-

[redacted]

(5) Add this solution to the gasoline mixture and stir until mixture thickens (about one minute).

(6) The mixture will thicken to a very firm butter paste within one to two days. The mixture can be thinned, if desired, by mixing in additional gasoline. Store in an air-tight container until ready to use.

d. Alternate Preparation Using Pyrethrum Extract Instead of Rosin.

(1) Replace rosin by the following:

Ingredient	Parts by volume	Used for	Common source
Pyrethrum extract (20%).	18.....	Insecticide, medicine.	Hardware stores, garden supply, drug stores.

(2) Measure 78 parts by volume of gasoline and place in a clean container.

***Caution:* Keep material away from open** [redacted]

(3) Dissolve the pyrethrum extract in the gasoline by stirring.

(4) In another container dissolve the lye in water.

[redacted]

***Caution:* Add lye to water slowly. Do not prepare this solution in an aluminum container.**

(5) Add 4 parts by volume of the lye solution to the gasoline mixture.

(6) Stir every 15 minutes until gel forms. Store in an air-tight container until ready to use.

e. Application

(1) To use gelled gasoline most effectively, it should be spread out over the surface of the material to be burned. This will start a large area burning at once. A match can be used to directly initiate this incendiary. A short time delay in ignition can be obtained by combining Fuse Cord (0101) or Improvised String Fuse (0102) and one of the igniter mixtures found in chapter 3. (For example, several spoonfuls of Sugar-Chlorate Mixture (0201) are placed in a nonabsorbent wrapping material. Fuse cord is buried in the center of the igniter mixture and the fuse is taped to the wrapping material. This assembly is placed directly on the gelled gasoline. Delay times are determined by the length of fuse. Suitable delay mechanisms are given in chapter 5 for delay times longer than those practical with fuse cord.)

(2) Gelled gasoline should not ordinarily be used with a delay longer than one hour because gasoline evaporates and this can reduce its effectiveness.

(3) The destructive effect of gelled gasoline is increased when charcoal is added. The charcoal will readily ignite and the persistent

[redacted]

fire from the charcoal will outlast the burning gasoline. It is recommended that at least one quart of gelled gasoline be used to ignite heavy wooden structures and large wooden sections. A minimum of one-half quart is recommended for wooden structures of small cross section.

0303.2 LYE-ALCOHOL SYSTEMS

a. Description. See Paragraph 0303.1.

b. Material and Equipment.

Ingredient	Parts by volume	Used for	Common source
Gasoline..	58.....	Motor fuel.....	Gas stations or motor vehicles.
Lye.....	2 (flake) or 1 (powder).	Drain cleaner, making of soap.	Food and drug stores, soap factories.
Water....	1 or 2....	(Always use about the same amount as dry lye).	
Ethyl alcohol.	3.....	Whiskey.....	Liquor stores.
Tallow...	14.....	Food.....	Fat extracted from solid fat or suet of cattle, sheep, or horses.

Spoon or stick for stirring
Two air-tight containers

Note. Lye is also known as caustic soda or sodium hydroxide. Allow for strength of lye. If only 50% (as in Drano), use twice the amount indicated above. Methyl (wood) alcohol, isopropyl (rubbing) alcohol or antifreeze product can be substituted for whiskey, but their use produces softer gels. Potassium hydroxide (caustic potash, potassa) may be used in place of lye.

[redacted]

(1) The following can be substituted for the tallow in order of preference:

(*a*) Wool grease (lanolin) (very good)—fat extracted from sheep wool.

(*b*) Castor oil (good).

(*c*) Any vegetable oil (corn, cottonseed, peanut, linseed, etc.).

(*d*) Any fish oil.

(*e*) Butter or oleo margarine.

(2) When using substitutes (1)(*c*) and (*e*) above, it will be necessary to double the recom-

mended amount of fat and of the lye solution for satisfactory thickening.

c. Preparation.

(1) Measure out the appropriate amount of gasoline and place in a clean container.

***Caution:* Keep material away from open flames.**

(2) Add the tallow to the gasoline and stir for about one-half minute to dissolve the tallow.

(3) Add the alcohol to the mixture.

(4) In another container dissolve the lye in water.

***Caution:* Add lye to water slowly. Do not prepare this solution in an aluminum container.**

(5) Add the lye solution to the gasoline mixture and stir occasionally until the mixture thickens (about one-half hour)

(6) The mixture will thicken to a very firm butter paste in one to two days. The mixture can be thinned, if desired, by mixing in additional gasoline. Store in an air-tight container until ready to use.

d. Application. See paragraph 0303.1.

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0303.3 LYE-BALSAM SYSTEMS

a. Description See paragraph 0303.1

b. Material and Equipment.

Ingredient	Parts by volume	Used for	Common source
Gasoline	80	Motor fuel	Gas stations or motor vehicles.
Either: Copaiba balsam, Copaiba resin, Jesuits' balsam.	14	Medicine, varnish, odor fixative.	Drug stores, varnish factories, perfume processors, natural oleoresin.
Or: Tolu balsam, Tolu resin, Thomas balsam.	14	Medicine, perfume, confectionery, fumigant, chewing gum.	Drug stores, perfume processors, candy manufacturers.
Lye	3	Drain cleaner, making of soap.	Food and drug stores, soap factories.
Water	3		

Spoon or stick for stirring
Two air-tight containers

Note. Lye is also known as caustic soda or sodium hydroxide. Allow for the strength of the lye. If only 50% (as in Drano), use twice the amount indicated above. Potassium hydroxide (caustic potash, potassa) may be used in place of lye.

c. Preparation.

(1) Dissolve the lye in water using a clean container.

***Caution:* Add lye to water slowly. Do not prepare this solution in an aluminum container.**

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(2) Stir gasoline and copaiba balsam in another clean container.

(3) Add the saturated lye solution to the gasoline mixture and stir until the gel forms. Store in an air-tight container until ready to use.

Note. Increase the lye solution to 10 parts by volume (5 parts lye, 5 parts water) if the gasoline does not thicken.

d. Application. See paragraph 0303.1.

0303.4 SOAP-ALCOHOL SYSTEMS

a. Description. See paragraph 0303.1.

b. Material and Equipment.

Ingredient	Parts by volume	Used for	Common source
Gasoline	38	Motor fuel	Gas stations or motor vehicles
Ethyl alcohol.	1	Whiskey	Liquor stores
Laundry soap.	20 (powder) or 28 (flake).	Washing	Food stores

Air-tight container
Spoon or stick for stirring

Note. Methyl (wood) or isoprophyl (rubbing) alcohols can be substituted for the ethyl alcohol. When a stronger alcohol (150 proof) or one of the dry alcohol substitutes is used, add an amount of water to make the concentration 50% by volume. (The *percent* alcohol is equal to ½ of the *proof*—160 proof is 75% alcohol.)

(1) Unless the word soap actually appears somewhere on the container or wrapper (at retail store level), a washing compound may be assumed to be a synthetic detergent. Soaps

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react with mineral salts in hard water to form a sticky insoluble scum while synthetic detergents do not. Synthetic detergents cannot be used.

(2) The following is a list of commercially available soap products (at retail store level):

Name	Manufacturer
Ivory Snow	Proctor and Gamble
Ivory Flakes	Proctor and Gamble
Lux Flakes	Lever Brothers
Chiffon Flakes	Armour
Palmolive Bar Soap	Colgate-Palmolive
Sweetheart Bar Soap	Manhattan Soap Company
Octagon Bar Soap	Colgate-Palmolive

(3) Home prepared bar soaps may be used in place of purchased bar soaps.

c. Preparation.

(1) Measure out the appropriate amount of gasoline and place in a clean container.

Caution: **Keep material away from open flames.**

(2) Add the alcohol to the gasoline.

(3) Add the soap powder to the gasoline-alcohol mixture, and stir occasionally until the mixture thickens (about 15 minutes).

(4) The mixture will thicken to a very firm butter paste in one to two days. It can be thinned, if desired, by mixing in additional gasoline. Store in an air-tight container until ready to [illegible]

d. Application. See paragraph 0303.1.

0303.5 EGG SYSTEM [66]

a. Description. See paragraph 0303.1.

b. Material and Equipment.

Ingredient	Parts by volume	Chemical name	Used for	Common source
Gasoline	85		Motor fuel	Gas stations or motor vehicles.
Egg whites (chicken, ostrich, duck,	14		Food, industrial processes.	Food stores, farms
Use any one of the following additives:				
Table salt	1	Sodium chloride	Food, industrial processes.	Sea water, natural brine, food stores.
Ground coffee (not decaffeinated).	3		Beverage	Food stores, coffee processors
Leaf tea	3		Beverage.	Cacao trees, food stores
Sugar	2	Sucrose	Sweetening foods, industrial [illegible]	Sugar cane, food stores.
Borax	2	Sodium tetraborate decahydrate.	Washing aid, industrial processes.	Natural in some areas, food stores.
Saltpeter (Niter).	1	Potassium nitrate.	Pyrotechnics, explosives, matches, medicine.	Natural deposits, drug stores
Epsom salts	1	Magnesium sulfate heptahydrate.	Medicine, mineral water, industrial processes.	Natural deposits, Kieserite, drug and food stores.
Washing soda (sal soda).	2	Sodium carbonate decahydrate.	Washing cleanser, medicine, photography	Food, drug, and photo supply stores.
Baking soda	2	Sodium bicarbonate.	Baking effervescent salts, beverages, [illegible] waters, medicine, industrial processes.	Food and drug stores
Aspirin (crushed).	2	Acetylsalicylic [illegible].	Medicine	Food and drug stores.

Spoon or stick for stirring
Two air-tight containers

c. Preparation.

(1) Separate the egg white from the yolk as follows:

(a) *Method 1.* Crack the egg at approximately the center. Allow the egg white to drain into a clean container. When most of the egg white has drained off, flip the yellow egg yolk from one-half shell to the other, each time allowing the egg white to drain into the container. Transfer the egg white to a capped jar for storage or directly into the container being used for the gelled flame fuel. Discard the egg yolk. Repeat the process with each egg. Do not get the yellow egg yolk mixed into the egg white. If egg yolk gets into the egg white, discard the egg.

(b) *Method 2.* Crack the egg and transfer (CAREFULLY SO AS TO AVOID BREAKING THE YOLK) the egg to a shallow dish. Tilt the dish slowly and pour off the egg white into a suitable container while holding back the yellow egg yolk with a flat piece of wood, knife blade, or fingers. Transfer the egg white to a capped jar for storage or directly to the container being used for the gelled flame fuel. Discard the egg yolk. Repeat the process with each egg being careful not to get yellow egg yolk mixed in with the egg white. If egg yolk

gets into egg white, discard the egg and wash the dish.

(2) Store egg white in an ice box, refrigerator, cave, cold running stream, or other cool area until ready to prepare the gelled flame fuel.

(3) Pour the egg white into a clean container.

(4) Add the gasoline.

Caution: **Keep material away from open flames.**

(5) Add the table salt (or one of its substitutes) and stir until the gel forms (about 5–10 minutes). Use within 24 hours. Thicker gelled flame fuels can be obtained by—

(*a*) Reducing the gasoline content to 80 parts by volume (NO LOWER); or

(*b*) Putting the capped jars in hot (65° C., 149° F.) water for ½ hour and then letting them cool to ambient temperature. (DO NOT HEAT THE GELLED FUEL CONTAINING COFFEE.)

d. Application. See paragraph 0303.1.

0303.6 LATEX SYSTEM

a. Description. See paragraph 0303 1.

b. Material and Equipment.

Ingredient	Parts by volume	Used for	Common stores
Gasoline	92	Motor fuel	Gas stations or motor vehicles.
Either:			
Latex commercial or natural.	7	Paints, adhesives, rubber products.	Natural from tree or plant, rubber cement, general stores.
Or:			
Guayule Gutta percha Balata.	7	Wire insulation, waterproofing, machinery belts, golf ball covers, gaskets.	Coagulated and dried latex, rubber industry.
Any one of the following:			
Dilute acetic acid (vinegar).	1	Salad dressing, developing photographic films.	Food stores, fermented apple cider or wine, photography supply.
Sulfuric acid, battery acid (oil of vitriol).	1	Storage batteries, material processing.	Motor vehicles, industrial plants.
Hydrochloric acid 1 (muriatic acid).	1	Petroleum wells, pickling and metal cleaning, industrial processes.	Hardware stores, industrial plants.
Air-tight container			
Spoon or stick for stirring			

Caution: **Sulfuric acid and hydrochloric acid will burn skin and ruin clothing. The fumes will irritate nose passages, lungs and eyes. Wash with large quantities of water upon contact.**

c. Preparation.

(1) Commercial rubber latex may be used without further treatments before adding it to gasoline.

(2) Natural rubber latex will coagulate (form lumps) as it comes from the plant. Strain off the thick part for use in flame fuel. If the rubber latex does not form lumps, add a small amount of acid to coagulate the latex and use the rubbery lump for gelling. It is best to air-dry the wet lumps before adding them to gasoline.

(*a*) *Using commercial rubber latex.*

1. Place the latex and the gasoline in the container to be used for the gelled gasoline and stir.

Caution: **Keep material away from open flames.**

2. Add the vinegar (or other acid) to the liquid in the container and stir again until the gel forms. Store in an air-tight container until ready to use.

Note. Use gelled gasoline as soon as possible because it becomes thinner on standing. If the gel is too thin, reduce the gasoline content (but not below 85% by volume).

3. Natural rubber latex coagulates readily. If acids are not available, use one volume of acid salt (alum, sulfates and chlorides other than sodium and potassium). The formic acid content of crushed red ants will coagulate natural rubber latex.

(*b*) *Using natural rubber latex.*

80 parts by volume of gasoline.

20 parts by volume of coagulated or dried rubber.

Let the rubber lump soak in the gasoline in a closed container two or three days until a gelled mass is obtained. Prepare the gelled gasoline using the above formulation. This gelled gasoline should be used as soon as possible after it has thickened sufficiently.

d. Application. See paragraph 0303.1

0303.7 WAX SYSTEMS

a. Description. See paragraph 0303.1.

b. Material and Equipment.

Ingredient	*Part by volume*	*Used for*	*Common source*
Gasoline	80	Motor fuel	Gas stations or motor vehicles.
Any one of the following waxes.			
Ozocerite mineral wax fossil wax ceresin wax.	20	Leather polish, sealing wax, candles crayons, waxed paper, textile sizing.	Natural deposits, general and department stores.
Beeswax	20	Furniture and floor waxes, artificial fruit and flowers, wax paper, candles.	Honeycomb from bees, general and department stores.
		72	
Bayberry wax myrtle wax.	20	Candles, soaps, leather polish, medicine.	Natural from myrica berries, general, department, and drug stores.
Lye	0.5	Drain cleaner, making of soap.	Food and drug stores, soap factories.

Two air-tight containers
Spoon or stick for stirring

***Caution:* Lye causes severe burns to eyes.**

Note. Lye is also known as caustic soda or sodium hydroxide. Allow for strength of lye. If only 50% (as in Drano), use twice the amount indicated above. Potassium hydroxide (caustic potash, potassa) may be used in place of lye.

c. Preparation.

(1) *Wax from natural sources.*

(*a*) Plants and berries are potential sources of natural waxes. Place the plants and/or berries in boiling water. The natural waxes will melt. Let the water cool, and the natural waxes will form a solid layer on the water surface. Skim off the wax and let it dry.

(*b*) Natural waxes which have suspended matter should be melted and screened through a cloth.

(2) *Gel from gasoline and wax.*

(*a*) Put the gasoline in a clean container.

***Caution:* Keep material away from open flames.**

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(*b*) Melt the wax and pour it into the gasoline container.

(*c*) Tightly cap the container and place it in hot water (sufficiently hot so that a small piece of wax will melt on the surface).

(*d*) When the wax has dissolved in the gasoline, place the capped container in a warm water bath and permit it to cool slowly to air temperature.

(*e*) If a solid paste of gel does not form, add another 10 parts by volume of melted wax and repeat (*b*), (*c*), and (*d*) above.

(*f*) Continue adding wax (up to 40 parts by volume) as before until a paste or gel is formed. If no paste forms at 80 parts by volume of gasoline and 40 parts by volume of melted wax, the wax is not satisfactory for gelled gasolines and may be used only in combination with alkali.

(3) *Gel from gasoline, wax and alkali.*

70 parts by volume of gasoline
29.5 parts by volume of melted wax
0.5 parts by volume of staurated lye solution

(*a*) Prepare the saturated lye solution by *carefully* adding one volume of lye (or two volumes of Drano) to one volume of water and stir with a glass rod or wooden stick until the lye is dissolved.

***Caution:* Lye causes severe burns to eyes. Add the lye to the water slowly. Let cool to room temperature and pour off the saturated liquid solution. Do not prepare this solution in an aluminum container.**

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(*b*) Prepare the gasoline-wax solution according to the method described above.

(*c*) After the solution has cooled for about 15 minutes, CAUTIOUSLY loosen the cap, remove it and add the saturated lye solution.

(*d*) Stir about every five minutes until a gel forms. If the gel is not thick enough, remelt with another 5 parts by volume of wax and 0.1 part by volume of saturated lye solution. Stir contents as before. Store in an air-tight container until ready to use.

Note. In addition to the listed waxes, the following may be used: candelilla wax, carnauba (Brasil) wax, Chinese (insect) wax, Japan (sumac) wax, montan (lignite) wax, and palm wax.

d. Application. See paragraph 0303.1.

0303.8 ANIMAL BLOOD SYSTEMS

a. Description. See paragraph 0303.1.

b. Material and Equipment.

Ingredient	Parts by volume	Chemical name	Used for	Common source
Gasoline	68		Motor fuel	Gas stations or motor vehicles.
Animal blood (sheep, cow, hog, dog, etc.).	30		Food, medicine.	Slaughter houses, natural habitat.
Any one of the following:				
Coffee (not decaffeinized).	2		Food, caffeine source, beverage.	Coffee processors, food stores.
Leaf tea	2		Food, beverage.	Tea processors, food stores.

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Ingredient	Parts by volume	Chemical name	Used for	Common source
Lime	2	Calcium oxide.	Mortar, plaster, medicine, ceramics, industrial processes.	From calcium carbonate, hardware and drug stores.
Baking soda	2	Sodium bicarbonate.	Baking, beverages, medicine, industrial processes.	Food and drug stores.
Epsom salts.	2	Magnesium sulfate heptahydrate.	Medicine, industrial processes, mineral water.	Natural deposits, drug and food stores.

Two air-tight containers
Spoon or stick for stirring

c. Preparation.

(1) *Animal blood serum.*

(a) Slit animal's throat by jugular vein. Hang upside down to drain.

(b) Place coagulated (lumpy) blood in a cloth or on a screen and catch the red fluid (serum) which drains through.

(c) Store in a cool place if possible.

Caution: **Animal blood can cause infections. Do not get aged animal blood or the serum into an open cut.**

(2) *Preparation of gelled gasoline.*

(a) Pour the animal bolod serum into a clean container and add the gasoline.

Caution: **Keep material away from open flames.**

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(b) Add the lime and stir the mixture for a few minutes until a firm gel forms. Store in an air-tight container until ready to use.

Note. Egg white may be substituted for up to ½ of the animal blood serum.

d. Application. See paragraph 0303.1.

0304. PARAFFIN-SAWDUST

a. Description.

(1) This item consists of a mixture of paraffin wax and sawdust. It is easily prepared and safe to carry. It is used to ignite wooden structures including heavy beams and timbers. It will also ignite paper, rags and other tinder type materials to build larger fires.

(2) This incendiary can be safely ignited by a match flame. However, any igniter listed in chapter 3 can be used in conjunction with specific delay mechanisms in chapter 5 for delayed ignition of this incendiary.

(3) All or part of the paraffin wax may be replaced by beeswax but *not* by vegetable or animal fats or greases.

b. Material and Equipment.

Paraffin wax, beeswax, or wax obtained by melting candles.
Sawdust.
Source of heat (stove, hot plate).
Pot.
Spoon or stick for stirring.

c. Preparation.

(1) Put enough wax in the pot so that it is about half full

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(2) Heat the pot on a stove or hot plate until the wax melts.

(3) Remove the heated pot from the stove or hot plate and shut off the source of heat. Add the sawdust to the melted wax until the pot is nearly full. Stir the mixture with a spoon or stick for a few minutes, being sure there is no layer of wax at the bottom of the pot which has not been mixed with the sawdust.

(4) While the mixture is in a fluid state, pour it into a waxed paper carton or other container. Upon cooling, the wax mixture will harden and take the shape of the container. The mixture can be stored for months without losing its effectiveness. If it becomes wet, it will be effective again when it is dried.

(5) A less effective incendiary may be made by melting some paraffin or beeswax, dipping sheets of paper in the molten wax for a few seconds, and removing the paper to let the wax harden. This waxed paper lights readily

from a match. Although not as hot or persistent or the paraffin-sawdust mixture, the waxed paper is an excellent incendiary and may be substituted in many instances for initiating readily ignitable materials. The paper may be wadded up, folded, or torn into strips.

d. Application.

(1) Place about a quart of the mixture in a paper bag and put the bag down on the object to be burned. A match may be used to ignite the bag which will then ignite the paraffin-sawdust mixture. The fire starts very slowly so there

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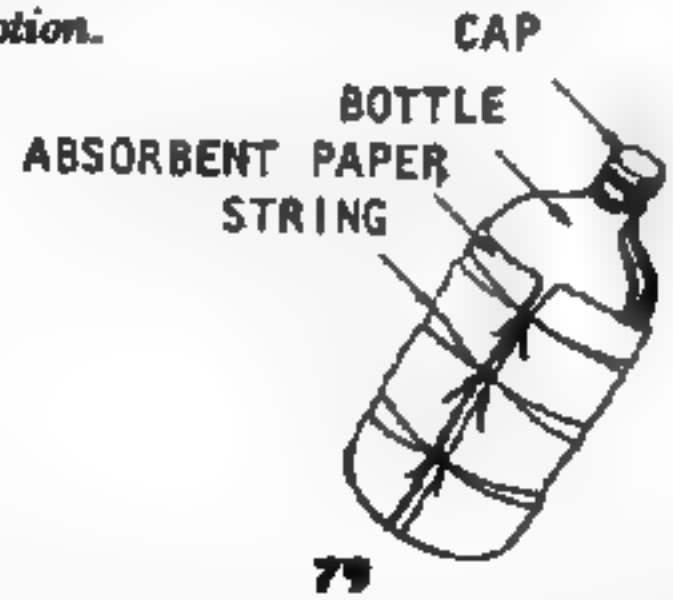
is no hazard involved, and it usually takes two or three minutes before the paraffin-sawdust mixture is burning strongly. This, of course, is a disadvantage where a hot fire is required quickly. Once started, however, this mixture burns vigorously because the paraffin itself gives a fairly hot flame and the sawdust acts like charcoal to increase the destructive effect.

(2) Where very large wooden beams or structures are to be burned use more of the mixture. A bag containing two or three quarts will be enough to set fire to almost any object on which paraffin-sawdust mixture can be used effectively.

(3) To be most effective on wood structures, this mixture should be in a pile, *never* spread out in a thin layer. If possible, place it under the object. When placing the incendiary in a packing box or in a room, place it in a corner.

0305. FIRE-BOTTLE (IMPACT IGNITION)

a. Description.



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This item consists of a glass bottle containing gasoline and concentrated sulfuric acid. The exterior of the bottle is wrapped with a rag or absorbent paper. Just before use, the rag is soaked with a saturated solution of granulated sugar and potassium chlorate. Thrown against hard-surfaced targets such as tanks, automotive vehicles or railroad boxcars, this fire bottle is a very effective incendiary.

b. Material and Equipment.

Concentrated sulfuric acid (para 0103).
Gasoline.
Potassium chlorate (powdered).
Sugar (granulated).
Jar or bottle, with cap or stopper (½ pint).
Cloth or absorbent paper.
Jar or bottle, with cap or stopper (1 quart).
String or tape.
Heat resistant glass or porcelain pot (1 pint capacity).
Heat source.
Glass funnel.
Spoon.
Small container for measuring.

c. Preparation.

(1) Using the funnel, pour the gasoline into the quart bottle until approximately two-thirds full.

Caution: Keep this material away from open flames.

(2) Slowly add concentrated sulfuric acid through the funnel to the gasoline in the bottle and fill the bottle to within one inch of the top. The funnel must be used to direct the concentrated acid into the gasoline in the center

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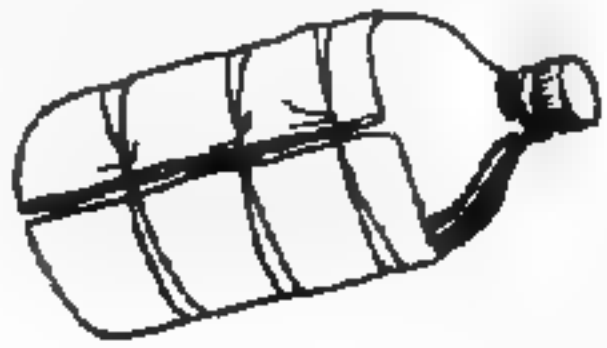
of the bottle. Stopper or cap the bottle securely.

Note. If only battery-grade sulfuric acid is available, it must be concentrated. See instructions under paragraph 0103.

(3) Flush the tightly capped bottle with water to remove any gasoline or acid adhering to the outside surface and dry the bottle. This *must* be done to avoid accidental combustion during the following steps.

(4) Wrap a clean cloth or several sheets of absorbent paper around the bottle. Fasten with strings or rubber bands.



(5) Prepare a saturated solution of granulated sugar and potassium chlorate in water as directed below.
(6) Add six measures of water to the porcelain pot and dry the measuring container with a clean rag or paper towel.
(7) Bring the water to a boil.
(8) Using a clean, dry spoon, place granulated sugar in the measuring container and add one and one-half measures of sugar to the boiling water
(9) Wipe the spoon with a clean rag or paper towel and place one measure of potassium chlorate into the boiling sugar water.
(10) Remove the pot of boiling mixture immediately from the heat source and shut off heat source.
(11) When the solution is cool, pour it into the small ½ pint bottle using the glass funnel and cap tightly.
(12) Flush this bottle with water to remove any solution or crystals adhering to the outside surface and dry the bottle. When the crystals settle, there should be about ⅓ liquid above the crystals.

Caution: Store this bottle separately from the other bottle containing gasoline and concentrated sulfuric acid.

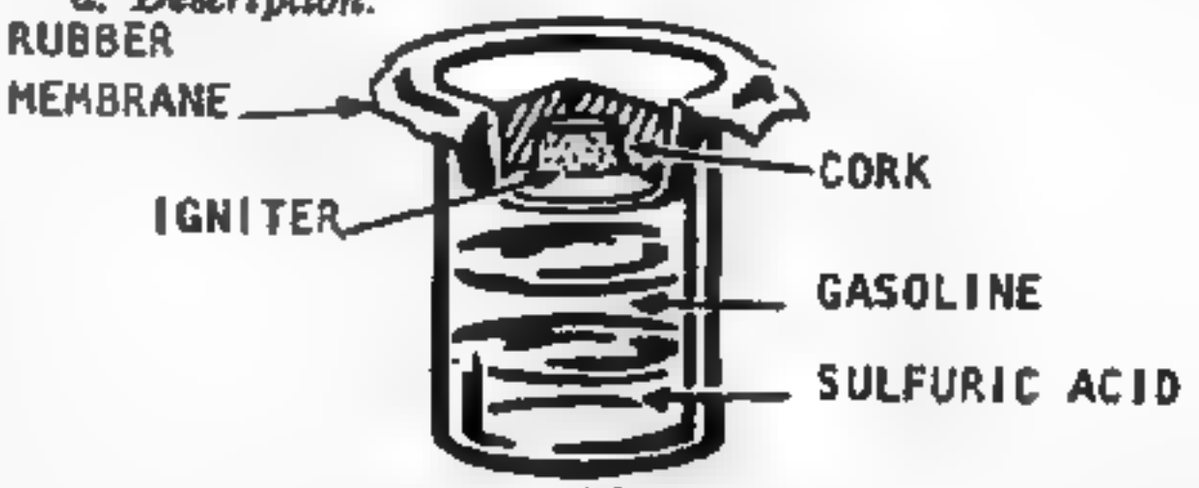
d. Application.

(1) Just prior to actual use, shake the bottle containing the sugar-potassium chlorate crystals and pour onto the cloth or paper wrapped around the gasoline-acid bottle. The fire bottle can be used while the cloth is still wet or after it has dried. However when dry, the sugar-potassium chlorate mixture is very sensitive to sparks, open flame, bumping and scraping. In the dry condition the bottle should be handled carefully.

(2) The fire bottle should be gripped in one hand and thrown like a hand grenade. Upon impact with a metallic or other hard surface, the bottle will break and the sugar-potassium chlorate will react with the sulfuric acid. This reaction ignites the gasoline which will engulf the target area in flames.

0306. FIRE BOTTLE (DELAY IGNITION)

a. Description.



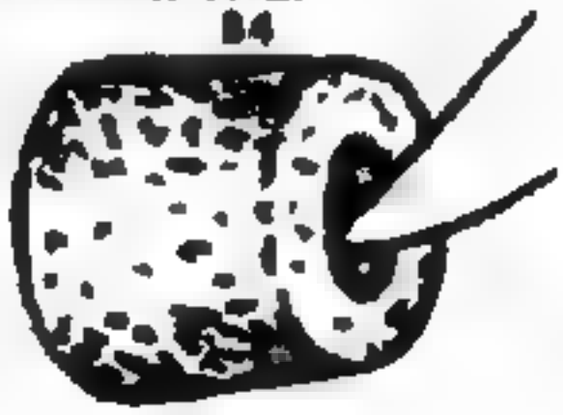
(1) This item consists of a bottle of gasoline and concentrated sulfuric acid which is ignited by the chemical reaction of the acid with Sugar-Chlorate Igniter (0201). A delay feature is incorporated in this incendiary. The amount of delay is determined by time it takes the sulfuric acid to corrode a rubber membrane and react with the igniter mix. Immediate ignition may also be achieved by breaking the bottle and allowing the ingredients to mix.
(2) Prepared fire bottles are stored upright. This allows the heavier acid to lay on the bottom, with the gasoline on top. When put in use, the bottle is inverted, allowing the acid to come in contact with the rubber membrane and to begin corroding it.

b. Material and Equipment.

Wide mouth bottle.
Cork or rubber stopper (must fit snugly in bottle).
Sheet rubber on rubber membrane.
Sugar-Chlorate Igniter (0201).
Concentrated Sulfuric Acid (0103).
Gasoline.

c. Preparation.

(1) Cut or drill a cavity on the bottom of the cork big enough to hold at least two teaspoonfuls of sugar-chlorate igniter. Be careful not to break through the cork. If the hole does go all the way through, it must be sealed with another smaller cork.



(2) Fill the bottle with a 50/50 concentration of gasoline and sulfuric acid. Pour the gasoline in first, then add the sulfuric acid carefully, making certain not to splash acid on the skin or in the eyes.

Note. If only battery grade sulfuric acid is available it must be concentrated before it can be used. See paragraph 0103 for details of concentration process.

(3) Fill the hole in the cork with Sugar-Chlorate Igniter (0201). Cover the side of the cork containing the igniter with a piece of thin rubber membrane and then force the cork into the gasoline-acid filled bottle. Take care to prevent any of the igniter mix from falling into the jar.

d. Alternate Method of Preparation.

(1) Drill or cut a hole all the way through the cork.
(2) Fill the bottle with gasoline and acid as described above.
(3) Place the rubber membrane over the cork and install in the bottle. Make certain that cork is fitted tightly and rubber membrane fully covers the inner portion of the bottle.

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(4) Fill the hole in the cork with igniter mixture as before and install a small cork in the hole covering the igniter mixture.

e. Application.

(1) To start the delay working invert the bottle. The acid will begin corroding the rubber membrane. When the acid breaks through, it will react violently and either break the bottle or blow out the cork stopper and ignite the gasoline.
(2) The Delay Fire Bottle works well on readily ignited materials where the scattering of the burning gasoline will start a number of fires at once. To ignite wooden structures, preparation such as piling up of flammable tinder and kindling is required.
(3) The delay time for initiation of the gasoline is slowed down in cold weather and may be stopped if the acid freezes. Check the delay time by testing the acid with the identical thickness rubber membrane at the temperature of expected use. Always use concentrated sulfuric acid.

0307. THERMITE

a. Description.

(1) Thermite is composed of magnetic iron flakes and aluminum powder. Thermite may be obtained as a manufactured item or may be improvised for use in welding machinery parts together and burning holes in metal structures. The termite reaction is initiated by strong heat and therefore cannot be directly ignited with a safety fuse or match.

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The following igniters, found in chapter 3, may be used to initiate thermite: Powdered Aluminum—Sulfur Pellets (0207), Magnesium Powder—Barium Peroxide Igniter (0210), and Subigniter for Thermite (0211).

(2) Thermite is very safe to handle and transport because of its high ignition temperature. It burns well in cold and windy weather. Thermite will penetrate a sealed metal container and ignite the contents. It may be easily improvised if aluminum powder and iron oxide particles of the proper size are available.

b. Material and Equipment.

Aluminum powder (no coarser than ground coffee).
Iron oxide flakes (Fe_2O_3—similar to coarse ground coffee).
Spoon or cup for measuring.
Jar or can with tight fitting lid.
Cardboard can with metal ends.

c. Preparation.

(1) Place three parts by volume of iron oxide and two parts by volume of aluminum powder into the jar. Leave enough empty space to facilitiate mixing.
(2) Tighten the lid on the jar, turn the jar on its side and slowly roll until the two powders are completely mixed. The mixture is now ready for use and may be stored for months in the sealed container.

d. Application.

(1) Thermite is used to attack metallic targets such as transformers, electric motors, file cabinets, gears, bearings, boilers, storage tanks

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and pipelines. In operation, the methods described below produce a quantity of molten metal that streams out the bottom of the unit. On contact with the target, the molten metal will cut through the outer metal casing and pour molten metal on the interior. Thermite is *not* recommended for use on moderate or heavy wooden structures or other applications where a persistent flame is required. Two basic techniques are described, one for burning holes in steel and the other for welding steel

parts together.

(a) *Burning holes.*

1. In order to penetrate a steel plate with the minimum quantity of thermite, the mass of ignited thermite must be held away from the target during the initial combustion period. This minimizes conductive heat loss (from the thermite to the target) during this period and results in the thermite attaining maximum combustion temperature. When that temperature is reached, the thermite is dropped onto the steel plate surface and a hole is burned through the plate. The following illustrates the method for burning a hole through a plate of ⅜ inch structural steel.

2. Cut a cardboard can (having metal ends) into two equal sections. Example of the type of cardboard container required are which contain household abrasive cleaners such as *AJAX, BON AMI* and *OLD DUTCH CLEANSER.*

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3. One section of the can trimmed to a height of 2 inches and two side vents are cut as shown below.

4. The other section is filled approximately ⅔ full with thermite. The thermite is then completely covered with one of the three above mentioned igniter materials to a depth of at least ¼ inch. Place the end of a length of Fuse Cord (0101) into the igniter mix, making certain that it does not extend into the thermite itself but ends in the center of the igniter mixture. Improvised String Fuse (0102) may be substituted for the Fuse Cord (0101) if desired.

5. The final assembly is constructed by placing the vented section, open face down, over the target area. The metallic end of this section is now facing up, away from the target surface. The section filled with thermite, igniter, and fuse is placed on top of the vented section. Both metal ends of the cardboard can are now touching.

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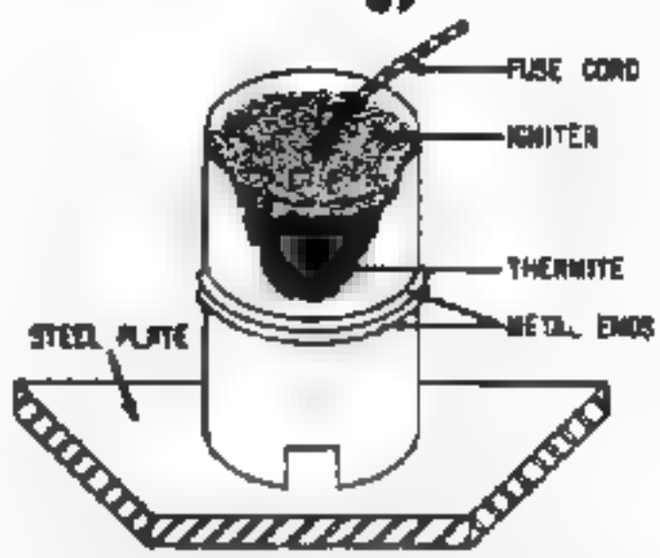

6. After ignition, the thermite burns a hole through the steel plate dropping extremely hot particles of molten slag into the interior of the steel container. The side vents cut in the bottom section of the can allow excess slag to run off and not close up the hole in the steel target.

(b) *Welding.*

1. A different method is employed when thermite is used to weld machinery components or plates together. The procedure is similar to that used for burning through steel except that the bottom stand-off is eliminated and the amount of thermite can be less than that used to burn through a ⅜ inch steel plate. The assembly is shown below.

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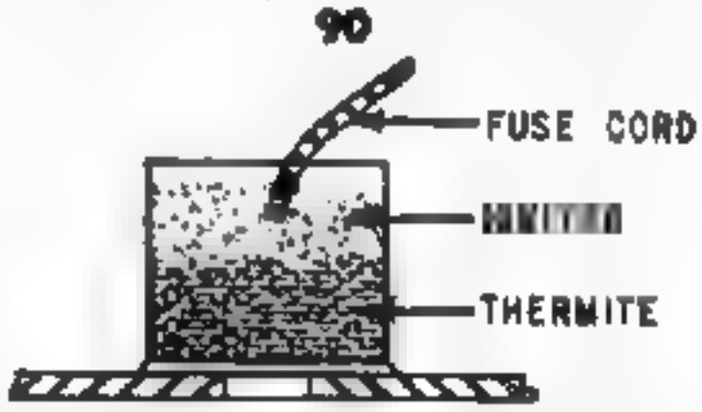

2. In this instance, heat is conducted from the thermite to the steel during the combustion period. Thus, the steel is heated to nearly the same temperature as the slag and a weld is effectively made

Caution: **Never attempt to ignite thermite without at least a few seconds delay time because it burns so quickly and so hot that the user could be seriously burned if he were nearby when ignition took place.**

0308. FLAMMABLE LIQUIDS

a. Description. Flammable liquids are an excellent incendiary for starting fires with easily combustible material. They burn with a hot flame and have many

uses as incendiaries Most of these liquids are readily available and they are easily ignited with a match. However, these liquids tend to flow off the target and their characteristic odor may cast suspicion on the person found carrying them.

b. Material and Equipment.

Can or bottle with tight fitting lid (minimum 1 pint capacity).

One of the following volatile liquids:

Gasoline	Cleaners naptha
Kerosene	Turpentine
Toluene or Toluol	Lighter fluid
Xylene or Xylol	Fuel oil
Benzene or Benzol	Alcohol

c. Preparation. No preparation other than placing the liquid into an air-tight container for storage and transportation to the target is required.

d. Application. The most effective way to use flammable liquids is to pour at least a pint of the liquid on a pile of rags or sawdust which have been place in a corner of a packing box or other wooden object. This procedure keeps the liquid concentrated in a small area and gives a more persistent flame for igniting wooden objects. If small pieces of charcoal are available, they should be soaked with the flammable liquid and placed on the target. The charcoal will ignite and give a hot, persistent glow that is long lasting. After placing the flammable liquid on the target, throw a lighted match on a soaked area. Do not stand too close when this is done.

0309. INCENDIARY BRICK

a. Description.

(1) This incendiary is composed of potassium chlorate, sulfur, sugar, iron filings and wax. When properly made, it looks like an ordinary building brick and can be easily transported without detection. The incendiary brick will ignite wooden walls, floors, and many other combustible objects.

(2) This incendiary can be directly ignited by all igniters listed in chapter 3, coupled with a specific delay mechanism found in chapter 5. To ignite this incendiary with White Phosphorus Solution (0209), the solution must first

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be poured on absorbent paper and the paper placed on top of the brick.

b. Material and Equipment.

	Parts by volume
Potassium chlorate (powdered)	40
Sulfur (powdered)	15
Granulated sugar	20
Iron filings	10
Wax (beeswax or ordinary candle wax)	15

Spoon or stick
Brick mold
Red paint
Measuring cup or can
Double boiler
Heat source (hot plate or stove)

c. Preparation.

(1) Fill the bottom half of the double boiler with water and bring to a boil.

(2) Place the upper half of the boiler on the lower portion and add the wax, sulfur, granulated sugar, and iron filings in the proper amounts.

(3) Stir well to bland all the materials evenly.

(4) Remove the upper half of the double boiler from the lower portion and either shut off the heat source or move the upper section several feet from the fire.

Caution: **Extreme care should be exercised at this point because accidental ignition of the mixture is possible. Some means of extinguishing a fire should be at hand, a fire extinguisher or sand. It is important to keep face, hands, and clothing at a reasonably safe distance during the remainder of the preparation. A face shield and fireproof gloves are recommended.**

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(5) CAREFULLY add the required amount of potassium chlorate and again stir well to obtain a homogeneous mixture.

(6) Pour the mixture into a brick mold and set aside until it cools and hardens.

(7) When hard, remove the incendiary from the mold, and paint it red to simulate a normal building brick.

d. Application.

(1) When painted, the incendiary brick can be carried with normal construction materials and placed in or on combustible materials

(2) A short time delay in ignition can be obtained by combining Fuse Cord (0101) or Improvised String Fuse (0102) and one of the igniter mixtures found in chapter 3. (For example, several spoonfuls of Sugar-Chlorate mixture (0201) are placed on the incendiary brick. Fuse cord is buried in the center of the igniter mixture and the fuse is taped to the brick Delay times are determined by the length of the fuse. Suitable delay mechanisms are given in chapter 5 for delay times longer than those practical with fuse cord.)

CHAPTER 5

DELAY MECHANISMS

0401. CIGARETTE

a. *Description.*

(1) This item consists of a bundle of matches wrapped around a lighted cigarette. It is placed directly on easily ignited material. Ignition occurs when the lighted portion of the burning cigarette reaches the match heads. This delay mechanism can be used to initiate all igniters listed in chapter 3 except Magnesium Powder—Barium Peroxide (0210) and Powdered Aluminum—Sulfur Pellets (0207). A cigarette delay directly ignites the following incendiaries: Napalm (0301), Gelled Gasoline (exotic thickeners) (0302), and Gelled Gasoline (improvised thickeners) (0303).

(2) The following *dry* tinder type materials may also be directly ignited by the cigarette delay mechanism: Straw, paper, hay, woodshavings and rags.

(3) Usually this delay will ignite in 15 to 20 minutes, depending on length of cigarette, make of cigarette, and force of air currents. A duplicate delay mechanism should be tested to determine delay time for various ambient conditions.

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(4) The cigarette must be placed so that the flame will travel horizontally or upward. A burning cigarette that is clamped or held will not burn past the point of confinement. Therefore, the cigarette should not contact any object other than matches.

b. *Material and Equipment.*

Cigarette.
Matches (wooden).
Match box.
String or tape.

c. *Preparation.*

(1) *Picket-fence delay.*

(a) Push one wooden match head into a cigarette a predetermined distance to obtain the approximate delay time.

(b) Tie or tape matches around the cigarette with the match heads at the same location as the first match in the cigarette.

(2) *Match box delay.*

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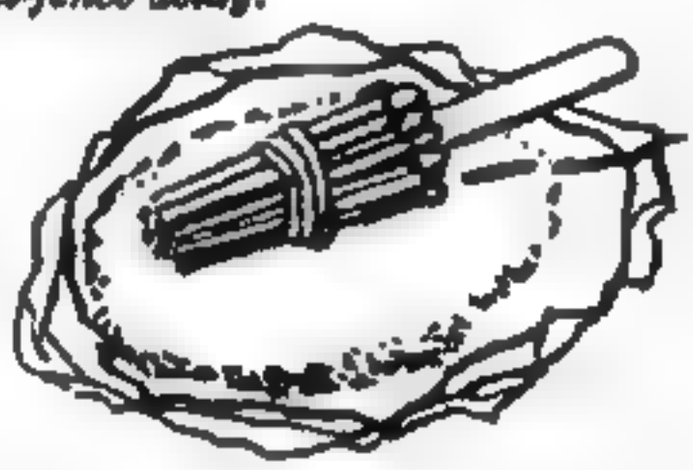
Tear out one end of the inner tray of a box of matches (the end next to the match heads). Push one match into the cigarette. *Insert* this cigarette into the bunch of matches and parallel to the matches at the center of the pack. Slide the tray out of the *inner* box, leaving the match heads and the cigarette exposed. The head of the match in the cigarette should be even with the exposed match heads.

d. *Application.*

(1) *Picket-fence delay.*



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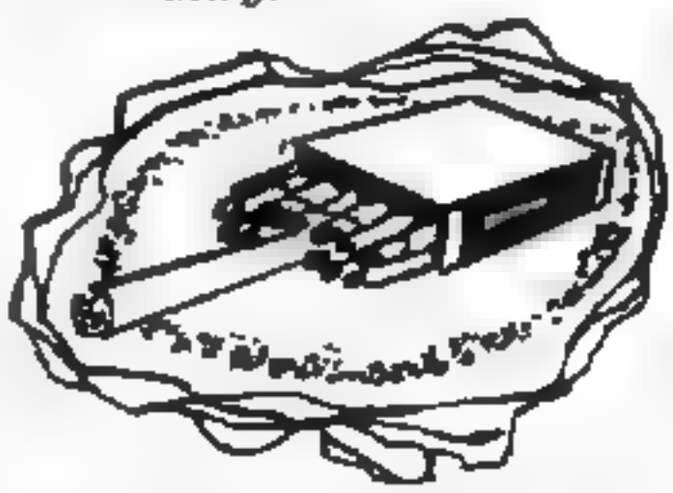
(a) Light the cigarette and place the delay mechanism on a pile of igniter mixture, paper, straw, or other dry tinder type material. Be sure that the portion of the cigarette between the lit end and the match heads is not touching anything.

(b) Pile tinder material all around the cigarette to enhance ignition when the match heads ignite.

(2) *Match box delay.*



(a) Place the delay so that the cigarette is horizontal and on top of the material to be ignited. Light the cigarette.

(b) Be sure ignitable material such as paper, straw, flammable solvents, or napalm is

placed close to the match heads. When using flammable solvents, light the cigarette away from the area of solvent fumes.

(c) To assure ignition of the target, sprinkle some igniter material on the combustible material. The match box delay is then placed on top of the igniter material.

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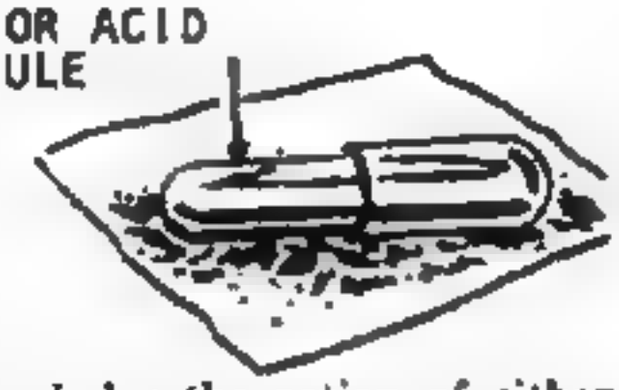
0402. GELATIN CAPSULE

a. Description.



Gelatin capsule delays work by the action of either water or concentrated sulfuric acid on the gelatin. When the liquid dissolves the gelatin, it contacts and reacts with an igniter mix. These delays can be used with various igniters, are easily prepared and easily carried. The disadvantage is that the delay times vary with temperature and they will not work at or below 32° F. Gelatin capsule delays will work with the following igniters:

(1) Water actuated igniters such as Sugar—Sodium Peroxide (0203), Silver Nitrate—Magnesium Powder (0208), and Aluminum Powder—Sodium Peroxide (0204).

(2) Concentrated sulfuric acid actuated igniters such as Sugar-Chlorate (0201), Fire Fudge (0202), Sugar—Sodium Peroxide (0203) Aluminum Powder—Sodium Peroxide (0204), Match Head (0205), and Silver Nitrate—Magnesium Powder (0208).

b. Material and Equipment.

Concentrated sulfuric acid or water.

Gelatin capsules (1 fluid ounce capacity).

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Igniter mixture.

Glass jar or bottle with glass or plastic stopper for carrying acid.

c. Preparation.

(1) Fill the gelatin capsule with either water or sulfuric acid, depending on which igniter is being used. Use a medicine dropper to fill the capsule. Wipe the outside of the capsule carefully and place it on a quantity of igniter mixture.

(2) Gelatin will slowly dissolve in either water or concentrated sulfuric acid, usually faster in water than in acid. Sulfuric acid should be handled carefully and only in glass or unchipped enamel containers

d. Application.

(1) Fill a gelatin capsule with one of the igniter mixes listed under *Description* above. Once the liquid is added to the capsule, the next operations should be done quickly. Pile the igniter mixture on and around the capsule. Then place incendiary material in contact with the igniter mixture. (In damp weather this method should not be used with water activated igniters because premature ignition may be caused by humidity in the air.)

(2) Use the following method in damp weather. Fill a gelatin capsule with one of the igniter mixes listed above. Be sure that both halves of the capsule fit tightly and that no igniter mix is clinging to the outside of the capsule. Place the capsule in a shallow glass or porcelain dish filled with water or concentrated sulfuric acid, depending on which type of

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igniter mix is used. Make sure the capsule is touching one edge of the bowl and quickly pile incendiary material close to the capsule so that when the capsule ignites, the incendiary will also ignite.

(3) The gelatin capsule delays work slowly in cold weather and will not work at or below 32° F. Capsule thickness also affects delay time. In water at 77° F.. a delay time of approximately 20 minutes can be expected, while the same type of capsule in concentrated sulfuric acid at 77° F. will give a delay time of approximately one hour. At a temperature of 50° F., the same type of capsule will give a 6 to 8 hour delay time in water and about 24 hours delay time in concentrated sulfuric acid. Delay times become less accurate at lower temperatures.

(4) The above listed delay times are given for one type of gelatin capsule only. Various types of capsules will give various delay times. Therefore, always check delay times for the capsule to be used.

(5) The sulfuric acid must be concentrated. If only battery-grade sulfuric acid is available, it must be concentrated before use to a specific gravity of 1.835 by heating it in an enameled, heat resistant glass or porcelain pot until dense, white fumes appear. See paragraph 0103 for details.

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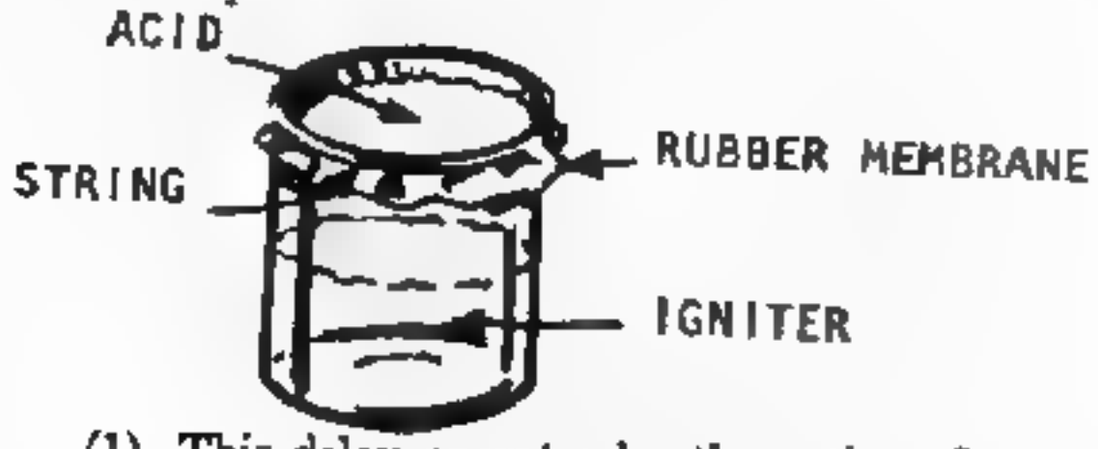
0403. RUBBER DIAPHRAGM

a. Description



(1) This delay operates by the action of concentrated sulfuric acid on a thin rubber diaphragm. As the acid eats through the diaphragm, it drips onto the igniter mix and combustion results. This delay can be used to initiate the following igniters listed in chapter 3: Sugar-Chlorate (0201), Fire Fudge (0202), Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), Match Head (0205), Silver Nitrate—Magnesium Powder (0208), and Fire Bottle (0306).

(2) The delay does not burn or glow, a very desirable feature where premature detection may occur. The main disadvantages of this type of delay are—

(*a*) Delay time fluctuates with temperature changes.

(*b*) Delay is not reliable below 40° F.

(*c*) Sulfuric acid involves hazards to the operator.

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b. Material and Equipment.

Concentrated sulfuric acid.
Thin rubber (such as balloons or condoms).
String, tape, or rubber bands.
Glass jar with glass stopper for carrying acid.
Wide-mouthed jar or can (approximately 1 pint capacity).

c. Preparation.

(1) Fill the wide mouth container three-quarter full with any one of the following igniter materials:

Sugar-Chlorate (0201).
Fire Fudge (0202).
Sugar—Sodium Peroxide (0203).
Aluminum Powder—Sodium Peroxide (0204).
Match Head (0205).
Silver Nitrate—Magnesium Powder (0208).

(2) Place the rubber diaphragm over the open end of the container and leave it loose enough to sag slightly into the jar. Either tie in place or secure with a rubber band.

(3) Pour about 1 fluid ounce of concentrated sulfuric acid into a small glass jar with a glass stopper and seal tightly.

d. Application.

(1) Place the jar with the rubber membrane at the desired target. Pile the material to be ignited around this jar so that when the flames issue from the jar, they will ignite the incendiary materials. *Do not put any of this igniter material on the rubber membrane.* Pour the 1 fluid ounce of concentrated sulfuric acid onto the rubber membrane. When the acid penetrates the rubber and drips onto the

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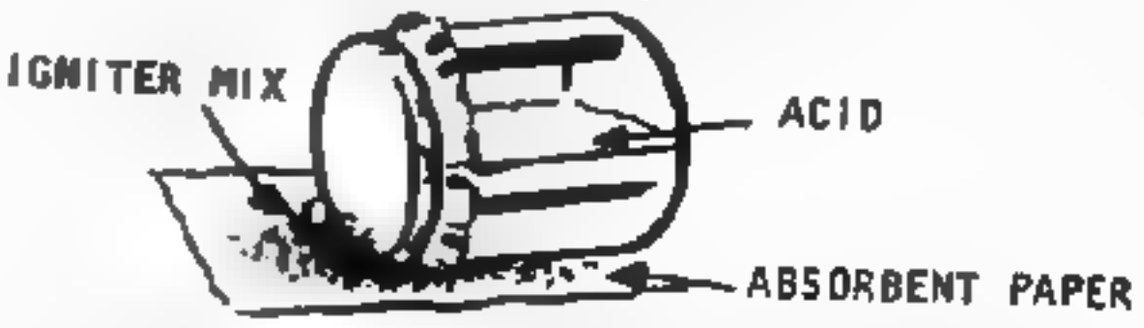
igniter mix, a chemical reaction occurs and combustion results.

(2) The time delay of this device depends on the kind and thickness of rubber used, and on the ambient temperature. Test a similar device before actual use on the target.

(3) Using a thin rubber membrane such as a condom at a temperature of 77° F., a delay time of 15 to 20 minutes is normal. This same delay when tested at 40° F. may take as long as eight hours to penetrate the rubber membrane. Do not use this delay at temperatures below 40° F.

(4) Another simple method of using this type of delay is to first fill a small jar half full of concentrated sulfuric acid. Tie or tape a rubber membrane over the open end of the jar. BE SURE NO ACID CAN LEAK OUT. Place the bottle on its side, on top of a small pile of igniter material which will ignite on contact with the acid. When the acid penetrates the membrane, combustion will occur as before. If thicker rubber is used, stretch the rubber tightly over the mouth of the jar. This will decrease the delay time because the acid will attack the stretched rubber more effectively.



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(5) A rubber glove may also be used as a membrane for this delay. Pour some concentrated sulfuric acid into the glove and suspend the glove over a pile of igniter material. When

the acid eats through the glove, it will drip onto the igniter and start a fire. A rubber glove will give a longer delay time than a condom because the material is thicker.

(6) The rubber membranes for use in this delay must be without pin holes or other imperfections. The sulfuric acid must be *concentrated*. If only battery-grade sulfuric acid is available, it must be concentrated before use to a specific gravity of 1.835 by heating it in an enameled, heat-resistant glass or porcelain pot until dense, white fumes appear. See paragraph 0103 for details.

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0404. PAPER DIAPHRAGM (SULFURIC ACID)

a. Description.

This device consists of a half-full jar of concentrated sulfuric acid, and a paper diaphragm. The paper diaphragm is a piece of paper tied securely over the mouth of the jar. When the jar is placed on its side, the acid soaks through or corrodes the paper. The acid then contacts the igniter material and causes it to burts into flames. This delay can be used for initiating the following igniters listed in chapter 3: Sugar-Chlorate (0201), Fire Fudge (0202), Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), Match Head (0205), Silver Nitrate—Magnesium Powder (0208).

b. Material and Equipment

Wide-mouthed jar.
Sulfuric acid (concentrated).
Paper.
String.

c. Preparation. Remove the cap from a wide-mouthed jar. Fill about half-full with concentrated sulfuric acid. Tie the paper securely over the mouth of the jar.

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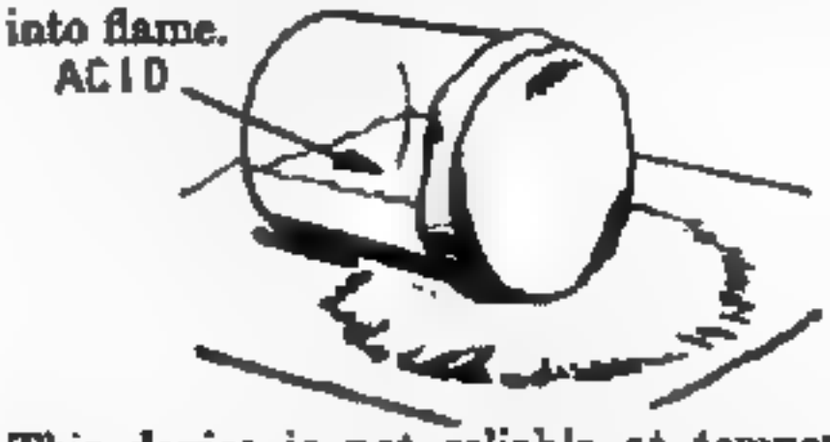
d. Application.

(1) Make a pile of dry flammable material such as rags, papers, empty boxes, or cartons. Spread out a piece of absorbent paper on this material. Spread igniter material on the absorbent paper and place the jar (on its side) on top of the igniter material. Make certain the jar does not leak. When the acid soaks through or corrodes the paper, it will contact the igniter material and cause it to burst into flame.



(2) This device is not reliable at temperatures below 40° F. The time delay depends on the thickness of the paper. A similar device should be tested to determine the delay provided by various thicknesses of paper. It should be tested at the temperature at which it will be used, to be sure of positive ignition. Ignition should occur in about 2 minutes at 68° F. when using writing paper. Higher ambient temperatures shorten delay times, and lower temperatures lengthen delay times.

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0405. PAPER DIAPHRAGM (GLYCERIM)

a. Description.

(1) This device consists of potassium permanganate crystals wrapped in layers of absorbent paper. Glycerin is brought into contact with the wrapped potassium permanganate crystals by slowly soaking through the paper. This wets the wrapped crystals causing combustion. This delay can be used for directly initiating all igniters listed in chapter 3 except White Phosphorus (0209). The igniting ability of this delay is increased when magnesium or aluminum particles are mixed with the potassium permanganate crystals.

(2) The following incendiaries (ch 4) can be directly ignited using this delay: Napalm (0301), Gelled Gasoline (exotic thickeners) (0302), Gelled Gasoline (Improvised thickeners) (0303), Paraffin-Sawdust (0304), and Incendiary Brick (0309). Other combustible dry materials such as paper, rags, straw, and excelsior can also be directly initiated. This delay is not recommended for use in temperatures below 50° F.

b. Material and Equipment.

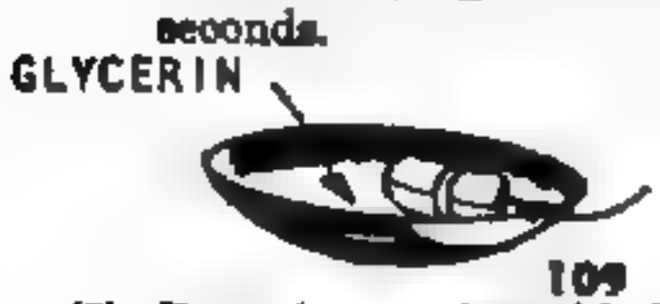
Absorbent paper (toilet paper, paper, toweling, newspaper).
Glycerin (commercial grade).
Magnesium or aluminum particles (consistency of granulated sugar).
Rubber bands or string.
Small shallow dish.
Potassium permanganate (consistency of coarse ground coffee).
Small bottle (approximately 1½ fluid ounces).
Spoon (perferably nonmetallic).

c. Preparation.

(1) Fill the small bottle with glycerin.
(2) Wrap a quantity of potassium permanganate crystals (a mixture of 85 parts potassium permanganate and 15 parts magnesium or aluminum particles can be substituted to produce a hotter flame) in absorbent paper. Make certain that none of the crystals fall out.
(3) The bottle and package may be carried by the person without hasard to himself, and will be available for use when needed.

d. Application.

(1) To use this delay, pour the glycerin into a small shallow dish or pan. Pile incendiary material around the dish so that when the glycerin ignites it will ignite the incendiary material. Place the paper container of potassium permanganate crystals into the pan of glycerin. When the glycerin soaks through the paper and contacts the potassium permanganate, ignition occurs within a few seconds.



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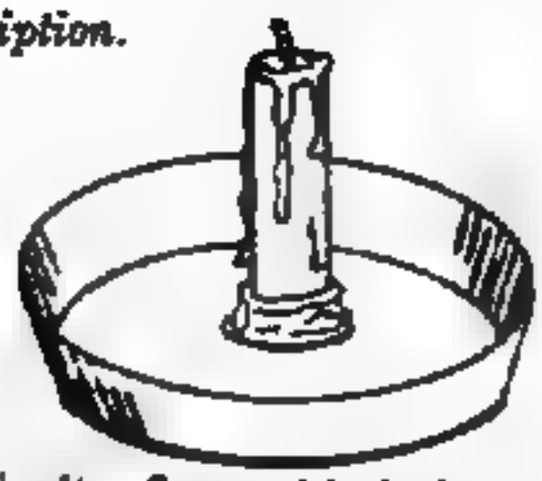
(2) By using various kinds of paper, different delay times can be obtained. Using more layers of paper for wrapping will increase the delay time. Using this delay at higher temperatures will also decrease the delay time. Delay times from one minute to approximately one hour are possible, depending on the conditions.
(3) The delay time should be checked under conditions which are similar to those expected at the target.

0106. CANDLE

a. Description.



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This delay ignites flammable fuels of low volatility such as fuel oil and kerosene. A lighted candle properly inserted in a small container of flammable liquid of low volatility causes ignition of the flammable liquid when the flame burns down to the liquid level. The flame from the burning liquid is used to ignite incendiary material such as paper, straw, rags, and wooden structures. The delay time is reasonably accurate, and may be easily calibrated by determining the burning

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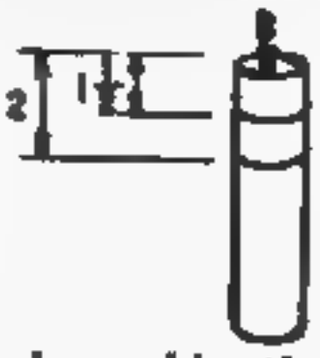
rate of the candle. No special skills are required to use this delay. Shielding is required for the candle when used in an area of strong winds or drafts. This delay is *not* recommended for use with *highly volatile liquids* because premature ignition may take place. This device is useful where a delay of one hour or longer is desired. The candle delay works well in cold or hot weather, and has the advantage of being consumed in the resulting fire, thus reducing evidence of arson.

b. Material and Equipment.

Candle.
Bowl.
Perforated can or carton.
Fuel oil or kerosene.
Matches.
Small piece of cloth.

c. Preparation.

(1) Make two marks on the side of the candle, 1½ inches and 2 inches from the top. Light the candle and record the times at which the wax melts at the marks on the side.



(2) The distance burned by the candle divided by the elapsed time determines the burning rate of the candle.

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d. Application.

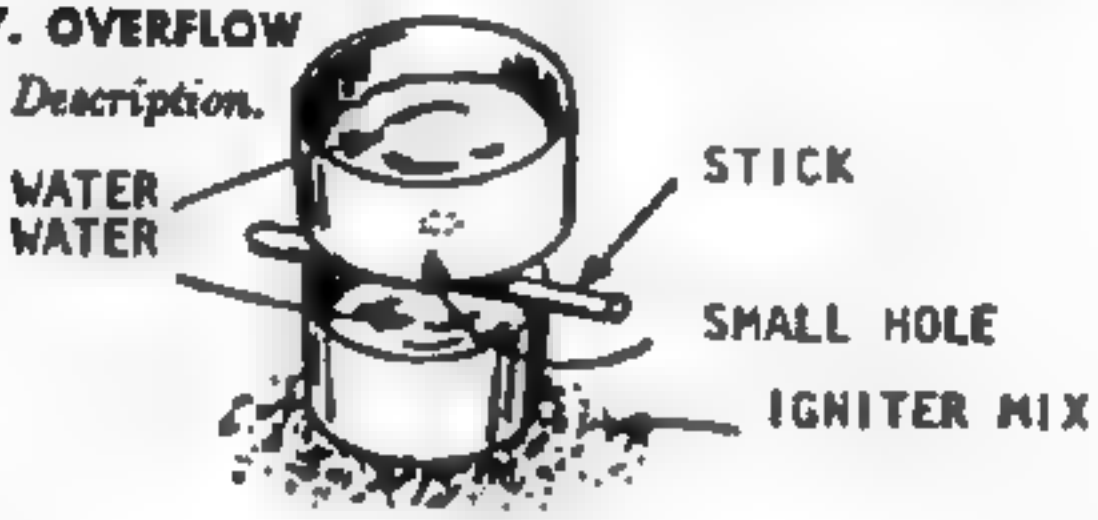
(1) Using a lighted candle of desired length, drip hot wax in the center of the bowl. Melt the base of the candle with a lighted match.

Firmly press the softened base of the candle into the hot wax in the center of the bowl. Be sure the candle will stand up securely without toppling over. Extinguish the candle. Wrap a small piece of cloth around the candle and slide it down to the bottom of the bowl. Place a quantity of fuel oil or kerosene in the bowl. Be sure that the level of the fluid reaches the cloth, so it will act as a wick. Pile the incendiary material around the bowl where it can catch fire after the fuel oil or kerosene ignites.

(2) If this delay must be set in a windy or drafty location, place a shield over it. Notch or punch holes in a metal can or cardboard carton at the bottom and sides for ventilation, and place this cover over the delay.

0407. OVERFLOW

a. Description.



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This item provides a time delay in starting a fire. It consists of two tin cans, with tops removed, and uses either water or glycerin to activate the igniter material. A hole is punched in the closed end of one can. This can is placed on top of the other can which is partially filled with the liquid. The top can is completely filled with the liquid. When the bottom can fills and overflows, the overflowed liquid will react with the igniter material placed around the bottom can This device is used for igniting the following water actuated igniters listed in chapter 3: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), and Silver Nitrate—Magnesium Powder (0208). Glycerin is used as the initiating liquid to ignite Potassium Permanganate glycerin (0206).

b. Material and Equipment.

Two tin cans.
Nail or punch.
Hammer.
Water or glycerin.
Can opener.

c. Preparation.

(1) Remove the tops from two cans.

(2) Punch or drill a small hole in the closed end of one of the cans.

(3) Partially fill the other can with either water or glycerin.

(4) Place the can with the hole in the bottom on top of the can partially filled with igniting fluid. Insert a twig or small stick between the two cans to allow the liquid to overflow from the bottom can.

(5) Fill the upper can with the same igniting fluid as that previously placed in the bottom can

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and determine the time required for the fluid to overflow from the bottom can. If two cans of the same size are used, either one may be used for the top. If different size cans are used, place the larger can on top. The delay is variable and adjustable depending on the sizes of the cans, the quantity of liquid used, or the diameter of the hole in the top can.

d. Application.

(1) Always test the glycerin delay at the temperature at which it will be used. Glycerin flows slowly when cold. Do not use water in this delay near or below its freezing point, 32° F.

(2) Place the delay in the target area and fill both upper and lower cans to the desired level with the appropriate liquid.

(3) Pile igniter material around the bottom of the overflow can so the activating liquid can easily make contact with the igniter material as it flows down the side of the can

0408. TIPPING DELAY—FILLED TUBE

a. Description.

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(1) This delay is composed of a hollow metal rod or bamboo filled with wet beans, rice or peas. The tube is inverted and placed in the center of a ring of igniter material and a small vial of water or acid is tied to the tube. When the wet beans expand, they lift and topple the tube, thereby spilling the acid or water onto the igniter causing combustion.

(2) This tipping delay may be used with a variety of igniters. They are easily prepared, and give fairly accurate delay times. This delay should not be used at temperatures near or

below 32° F. when water is used as the initiator due to freezing. The following water actuated igniters listed in chapter 3 can be used with this mechanism: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204) and Silver Nitrate—Magnesium Powder (0208). The delay may be used with concentrated sulfuric acid to initiate the above igniters and the following acid activated igniters: Sugar-Chlorate (0201), Fire Fudge (0202), and Match Head (0205). This delay may be used with the Glycerin—Potassium Permanganate Igniter (0206).

b. Material and Equipment.

Metal tube, pipe or piece of bamboo closed at one end, 4 to 6 inches long and 1 inch inside diameter, or glass test tube of similar dimensions.

Small glass vial or bottle with open mouth of 1 fluid ounce capacity.

String or rubber bands.

Rice, peas, or beans.

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Water.

Concentrated sulfuric acid.

c. Preparation. The pipe or tube may be made of any material. It must be closed at one end and flat at the other in order to stand vertically. A large glass test tube is ideal for this purpose.

(1) Using some string or rubber bands, attach the small vial to the larger tube. Attach the vial near the top with the open end of the vial pointing up and the open end of the tube down.

(2) This assembly should stand up without toppling over. If it appears unsteady, move the vial downward slightly. A final adjustment may be required when the delay is filled with the required materials.

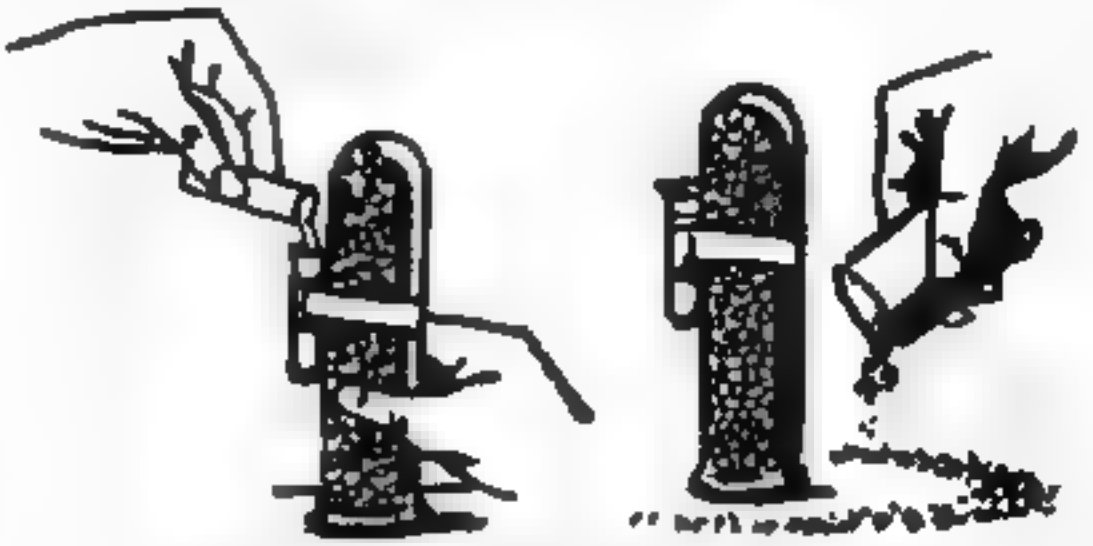
d. Application.

(1) Rice will usually give delays of about ten to twenty minutes. Peas and beans will usually give delay times up to 4 or 5 hours. Whichever is used it must be first tested to determine the delay time for the tube that will be used.

(2) To use this device, tightly pack the piece of pipe or bamboo with rice, peas or beans

[illegible]

depending on what delay time is required. Add enough water to completely moisten the beans and quickly pour off the excess water. Place the pipe open end down, and immediately fill the small vial with water or concentrated sulfuric acid, depending on which igniter is being used.



(3) Place a quantity of the igniter mixture in a ring around the delay assembly. Make the ring of such diameter that when the tube falls over, the acid or water from the vial will spill onto the igniter mixture.

(4) Place incendiary material where the flame from the igniter will start it burning.

(5) Another way in which the tipping delay can be used is to fill the small vial with glycerin instead of water or acid and then spread potassium permanganate crystals in a ring around the delay. When the glycerin is spilled onto the crystals, combustion will occur and ignite the incendiary material. The glycerin igniter will not work in temperatures below 50° F.

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(6) It is recommended that this device be tested at the same temperature at which it is to be used.

0409. TIPPING DELAY—CORROSIVE OR DISSOLVING ACTION

a. Description.

(1) This device consists of a vial of initiating liquid supported by a tripod. One of the legs which supports the vial of liquid is dissolved by a fluid. The center of gravity of the structure changes and the structure topples

over. The contents of the vial spill onto an appropriate igniter mixture and combustion occurs.

(2) This corrosive or dissolving tipping delay may be used with a variety of igniters. However, it should not be used at temperatures near or below 32° F. when water is used as the initiator due to freezing of the water.

(3) The following water actuated igniters listed in chapter 3 can be used with this mechanism:

[illegible]

Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204) and Silver Nitrate—Magnesium Powder (0208). The delay may be used with concentrated sulfuric acid to initiate the above igniters and the following acid activated igniters: Sugar-Chlorate (0201), Fire Fudge (0202), and Match Head (0203). This delay may be used with the Glycerin—Potassium Permanganate Igniter (0206)'

b. Material and Equipment.

Three wooden sticks or wooden pencils (approximately 6 inches long by ¼ inch diameter).
Glass vial (1 fluid ounce capacity).
String, tape or rubber bands.
Any one of the igniter mixtures mentioned above.
One of the following combination of items:

(1) Long sticks of hard candy and water.
(2) Lengths of bare copper wire and concentrated nitric acid.
(3) Iron nails or wire approximately 1/16 inch diameter by 4 inches long and concentrated hydrochloric acid.
(4) Iron nails or wire and saturated cupric chloride solution.

2 glass containers with glass stoppers for carrying acid.
Shallow glass or porcelain bowl such as soup bowl or ink bottle.

c. Preparation.

(1) Make a tripod out of three sticks, taping them together at the top. Two legs should be the same length; the third should be about 2—3 inches shorter.

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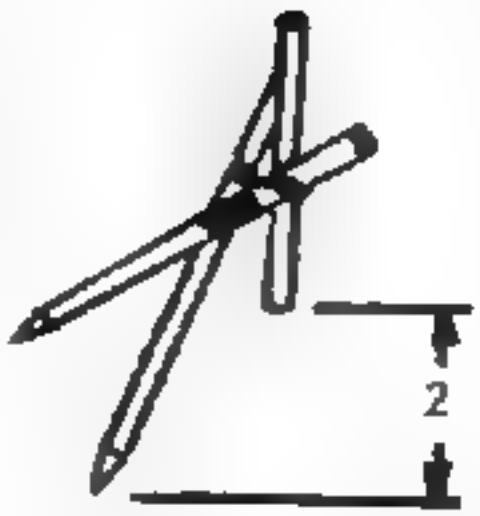
(2) Tape to the short leg, either a stick of hard candy, piece of heavy bare copper wire, steel nail, or steel wire, adjusting the length so that the wire leg stands almost vertically.

(3) The finished tripod should have a distance of about 4—5 inches between any two legs.

(4) To the top of the tripod, on the short leg,



firmly tape or tie the small 1-fluide ounce capacity vial, open end up. Make certain that the tripod still stands upright after attaching the vial. The distance between legs may have to be varied to keep the tripod barely standing upright.

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d. Application.

(1) To use the delay device, insert the leg of the tripod which has the candy, wire, or nails into a glass or porcelain bowl. Fill the vial at the top of the tripod with either water, concentrated sulfuric acid, or glycerin, depending on which igniter is being used. Spread a quantity of the proper igniter material in a ring around the tripod, placing it where the spilled initiating liquid is certain to contact it. Fill the glass or porcelain bowl with the prescribed liquid for dissolving the leg of the tripod in the bowl. For hard candy the liquid is water; for copper wire the liquid is concentrated nitric acid; for steel nails the liquid may be either concentrated hydrochloric acid, or a saturated solution of cupric chloride.

(2) No definite delay times can be established for these delays because of factors such as temperature, solution concentration, and imperfections in the leg of the tripod. Prior to use, test the device under conditions expected

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at the target. The following table should be used merely as a guideline of expected delay times for the various materials.

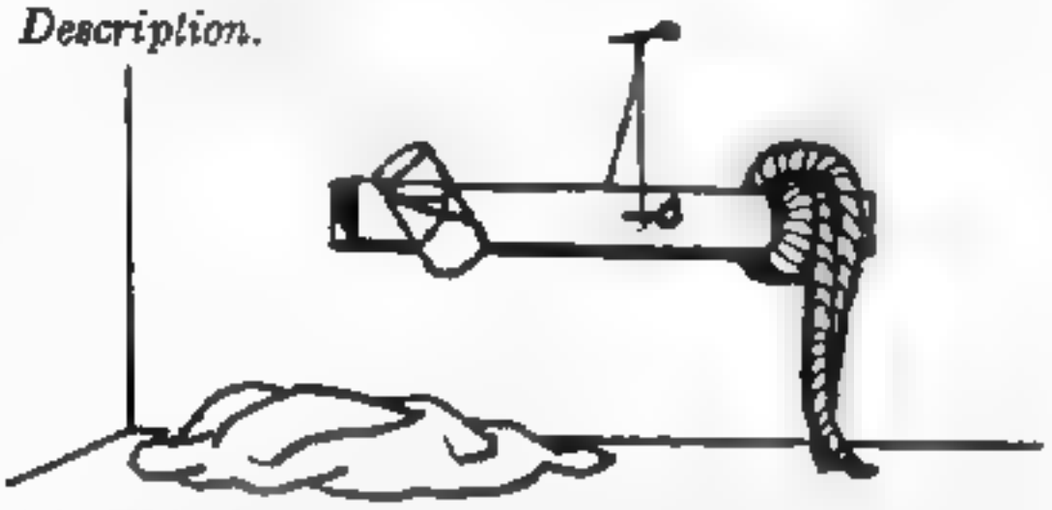
Delay material	*Delay time*
Hard candy plus water	5—10 minutes
Copper wire plus concentrated nitric acid	2—5 minutes
Copper wire plus nitric acid diluted with an	45—60 minutes

equal volume of water	
Steel wire or nails plus concentrated hydrochloric acid.	24 hours to 7 days
Steel wire or nails plus cupric chloride solution.	10 minutes to 5—6 hours.

(3) The delay time will vary greatly with only moderate changes in temperature. Do not use this type of delay mechanism where accurate delay times are required.

0410. BALANCING STICK

a. Description.



(1) This delay device consists of a piece of wood or stick, a small vial, a nail, a piece of string, and a long strip of cloth. A hole is drilled through the middle of the stick. The vial is

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fastened to one end, and the strip of cloth to the other. The length of the cloth is adjusted so that the rod just balances on a nail passing through the hole when the vial is ¾ full. The cloth is wetted with solvent to make it heavy and the vial is filled with initiating liquid to maintain balance. As the solvent evaporates, the end of the stick which supports the vial of initiating liquid becomes heavier than the end supporting the cloth. The unbalanced stick rotates about the nail until the initiating liquid spills onto the igniter mixture and combustion occurs. Fire then spreads to and ignites incendiary material

(2) This device may be used with a variety of igniters However, it should not be used at temperatures near or below 32° F. when water is used as the initiator due to freezing of the water. The following water actuated igniters listed in chapter 3 can be used with this mechanism: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204) and Silver Nitrate—Magnesium Powder (0208). The device may be used with concentrated sulfuric acid to initiate the above igniters and the following acid activated igniters: Sugar-Chlorate (0201), Fire Fudge (0202), and Match Head (0205). It may also be used with the Glycerin—Potassium Permanganate Igniter (0206).

b. Material and Equipment.

Piece of wood (⅜ by ⅞ by 16 inches).
2 Nails.

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String.
Strip of cloth.
2 glass vials (1 fluid ounce) with stoppers.

c. Preparation.

(1) Drill a hole through the middle of the stick as shown below.

(2) Insert a nail through the hole. The nail should permit the stick to turn freely. Tie a piece of string (4–6 inches in length) to both ends of the nail, forming a loop. It is not important that the stick balance exactly.

(3) To one end of the stick tape a small glass vial. Tilt the vial when attaching it so that when this end of the stick is about 8 inches above the other end, the vial will be vertically upright. On the other end of the stick tie a strip of cloth, rag, or rope. This strip should be heavy enough so that the stick is balanced when the vial is about ¾ full of initiating fluid.

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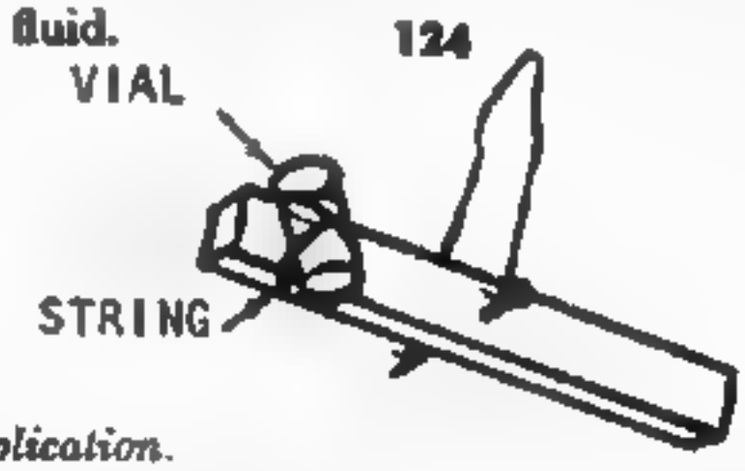

d. Application.

(1) To use this delay, drive a nail (approximately 4 inches long) into a wall or wooden box about 8 inches above the floor, leaving at least 2 inches of the nail projecting. Place the loop of string on the nail near the head of the nail. The stick should not touch the box or wall, but must swing freely. The rag should touch the floor. Pour enough solvent on the rag to soak it thoroughly (approximately 1 fluid ounce). Working quickly, fill the vial with initiating liquid and balance the rod by shifting the cloth. Spread a quantity of appropriate igniter mixture on the floor where the initiating liquid will spill when the solvent

on the cloth evaporates. In a few minutes the solvent will evaporate, causing the stick to become unbalanced. The vial will tilt with the stick and, the liquid in the vial will pour out and initiate the igniter mixture.

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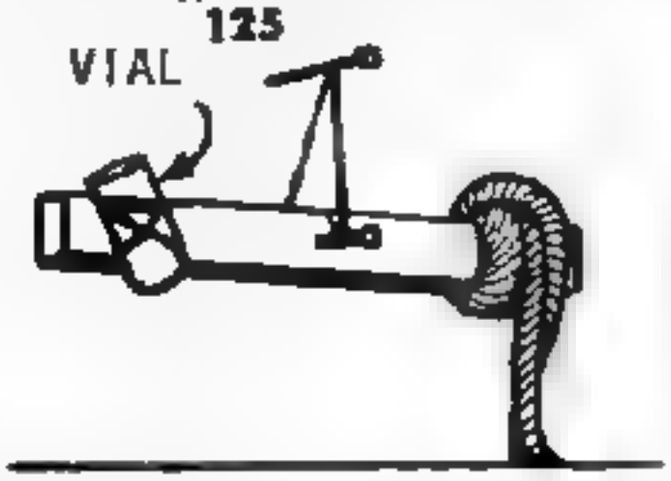
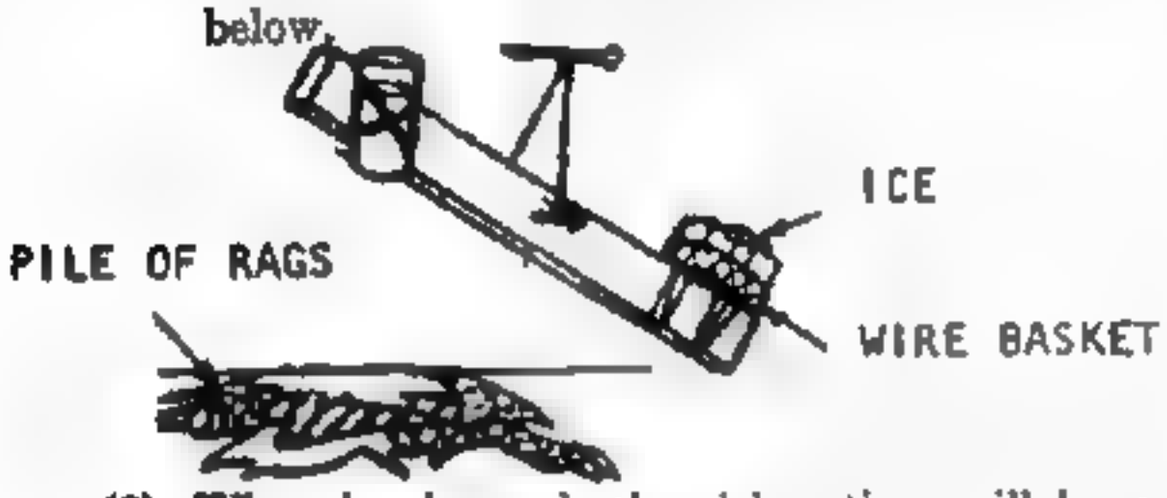


(2) Where no solvent is available or where the odor of solvent may make the device easy to detect, do not use cloth soaked with solvent. Use a wire basket containing ice as shown below.



(3) When ice is used, the delay time will be a matter of minutes, depending on the ambient temperature. Ice cannot be used at temperatures near 32° F. Be sure that the drippings from the melting ice does not wet the igniter or interfere with initial combustion of flammable material.

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DELAY: STRETCHED RUBBER BAND

a. Description.

This item utilizes a rubber band, which has been soaked in gasoline or carbon disulfide until it has considerably expanded. After removal of the rubber band from the solvent, the rubber band is attached to a wall and to a bottle containing igniter fluid. As the rubber band contracts due to solvent evaporation, the bottle is tipped and initiator liquid comes in contact with an appropriate igniter material. This stretched rubber band delay may be used with a variety of igniters. However, it should not be used at temperatures near or below 32° F. when water is used as the initiator because the water freezes. The following water actuated igniters listed in chapter 3 can be used with this mechanism: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), and Silver Nitrate—Magnesium Powder (0208). The delay may be used with concentrated sulfuric acid to initiate the above igniters and the following acid activated igniters: Sugar-Chlorate (0201), Fire Fudge (0202), and Match Head (0205). This delay may be used with Glycerin—Potassium Permanganate Igniter (0206).

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b. Material and Equipment.

Bottle or jar (1 to 2 fluid ounce capacity).
Rubber bands.
Gasoline or carbon disulfide.
Air tight container for carrying the gasoline or carbon disulfide.
Nails.
Igniter.

c. Preparation.

(1) Fill a bottle (1 to 2 fluid ounce capacity) with water, acid, or glycerin, depending on which igniter is to be used.
(2) Soak the rubber bands in gasoline or carbon disulfide for about one hour. Do not soak too long or they will become excessively weakened.

d. Application.

(1) At the place where the delay is to be used, drive a large headed nail into the wall, leaving about 2 to 2½ inches exposed. Loop the rubber bands over the head of the nail. Place the bottle two bottle heights away from the nail. Quickly loop the free end of the rubber bands over the neck of the bottle. Move the bottle back and forth until there is just enough tension in the rubber bands to hold the bottle without it toppling when a pencil or twig is placed under the far end. The stick under the end of the bottle is used as a tilt device to make sure that the bottle topples over when the rubber band contracts.
(2) Place some incendiary material close to the bottle. Sprinkle a quantity of igniter mixture about the area in which the liquid will be spilled. As the solvent evaporates, the rubber

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bands will shrink, tip the bottle, spill the liquid, and initiate the igniter material.

Note. Always set up the bottle before spreading the igniter mixture.

DELAY: ALARM CLOCK

a. Description.

(1) This device is used for igniting materials after a definite delay time. The device employs a manually-wound alarm clock, with the alarm bell removed, as the timing mechanism. A piece of string is fastened to the key used to wind the alarm. The other end of the string is fastened to a bottle of appropriate initiating liquid. When the modified alarm mechanism is tripped, the winding key will reel in the string and overturn the bottle of initiating liquid and start a fire.

(2) This alarm clock delay may be used with a variety of igniters. However, it should not be used at temperatures near or below 32° F. when water is used as the initiator because the water freezes. The following water actuated

igniters listed in chapter 3 can be used with this mechanism: Sugar—Sodium Peroxide (0203), Aluminum Powder—Sodium Peroxide (0204), and Silver Nitrate—Magnesium Powder (0208). The delay may be used with concentrated sulfuric acid to initiate the above igniters and the following acid activated igniters: Sugar-Chlorate (0201), Fire Fudge (0202), and Match Head (0205). This delay may be used with Glycerin—Potassium Permanganate (0206).

(3) This device will produce fairly accurate delay times between one and eleven hours.

Caution: **The ticking sound of the clock may reveal the presence of the device.**

b. Material and Equipment.

Alarm clock, manually wound (without bell, if possible).
Bottle.
String.
Initiator liquid.
Cloth or absorbent paper.

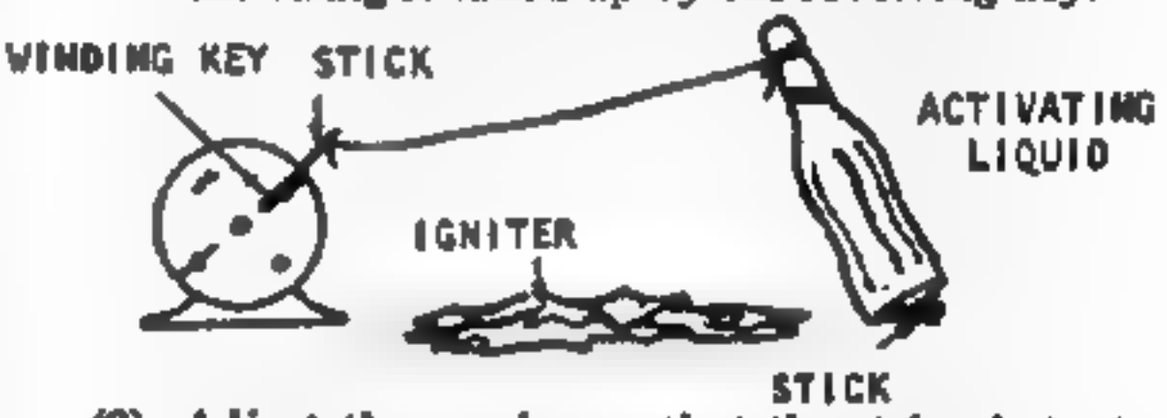
c. Preparation.

(1) Remove the bell or striker from the clock.
(2) Fully wind time and alarm springs.
(3) Set desired time on alarm.
(4) Tie the string to the alarm key so that it will be pulled when the alarm mechanism is tripped. If necessary, tie a twig or stick to the alarm key to obtain a longer level.

d. Application.

(1) Tie the string to the alarm key or stick. Set the clock in place and anchor it if necessary. Muffle the clock with rags, making sure that

the rags do not interfere with the reeling action of the alarm mechanism Tie the free end of the string to the bottle of activating liquid. The bottle should be tilted in the direction of the fall by a pencil or twig. When this device is placed on a smooth surface, the clock should be taped, tied, or weighted down to prevent it from sliding when the tension in the string is taken up by the revolving key.



(2) Adjust the spacing so that the string is taut. Place a cloth or an absorbent paper towel where the contents of the bottle will be spilled. Place a quantity of igniter mixture on the cloth or paper towel. Partially overlap the igniter mixture with a flammable material so as to assist combustion.

CHAPTER 6

SPONTANEOUS COMBUSTION

0501. SPONTANEOUS COMBUSTION

a. Description.

(1) Spontaneous combustion is the outbreak of fire in combustible material that occurs without application of direct flame or spark. A combustible material such as cotton waste, sawdust, or cotton batting is impregnated with a mixture of a vegetable oil and specific drying oils known as driers. This impregnated combustible material is placed in a container which provides confinement around the sides and bottom. Heat produced by the chemical action of the driers in the oil is transferred to the confined combustible material with resultant outbreak of fire. Prepared igniter materials such as Fire Fudge (0202) or initiator material such as Fuse Cord (0101) can

be used with the impregnated combustible material to increase reliability and decrease ignition delay time.

(2) The chemical reaction that supplies heat in the spontaneous combustion device becomes faster as the surrounding temperature rises. Conversely, as the temperature drops ignition delay time increases. In addition, ignition delay time varies somewhat with type of

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vegetable oil, type of drier, type of combustible material, confinement, density of the oil impregnated combustible material, and ventilation. Devices planned for use should be tried in advance to establish delay time.

(3) These devices operate with a natural delay caused by the chemical reaction time of the drying process in the oil. The user places the device and is away from the scene when the fire starts. Spontaneous combustion devices have the added advantage of using items seen daily around shop, plant, or office. Containers for confining the impregnated combustible material can be small waste paper baskets, packing boxes, ice cream containers, paper bags and other items common to a particular operation. Combustible materials such as cotton waste, cotton batting, or sawdust are also common in many manufacturing plants. For these reasons, spontaneous combustion devices are useful and clever sabotage items.

(4) It is recommended that these devices be covertly used to ignite readily flammable material such as rags, dry paper, dry hay, wooden and cardboard boxes, wooden structures, and other similar targets.

b. Material and Equipment.

Ingredient	*Used for*	*Common source*
Vegetable Oils		
Boiled linseed oil	Paint manufacture	Hardware stores
Raw linseed oil	Paint manufacture	Hardware stores
Safflower oil	Food	Drug and food stores
Tung oil (China wood).	Paint manufacture	Paint manufacturers

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Ingredient	*Used for*	*Common source*
Driers		
Cobalt (6%)	Paint manufacture	Paint manufacturers
Lead (24%)	Paint manufacture	Paint manufacturers
Manganese (can be substituted for cobalt).		
Lead oxide (can be substituted for lead).		

Combustible Materials		
Cotton waste	Machine shops, maintenance shops.	By-product of textile manufacture.
Cotton batting	Furniture manufacture.	Felt & textile manufacturers.
Sawdust	Water-oil-grease absorbent.	By-product of food working
Kapok	Life jackets, furniture padding, bedding.	Furniture manufacturers, food products manufacturers.
Miscellaneous Items		
Cardboard or paper container.	General	Commonly available
Stick approximately 1½ inches in diameter.	General	Commonly available
Sharp knife	General	Commonly available
One pint wide-mouth jar.	General	Commonly available
Teaspoon	General	Commonly available
Fire Fudge Igniter (optional).	Igniter	See paragraph 0202
Fuse Cord (optional).	Initiator	See paragraph 0101

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Proportions of Mixture

System	*Vegetable oil*	*Cobalt drier (teaspoon)*	*Lead drier (teaspoon)*	*Combustible material (lightly packed)*
1	Boiled linseed oil, ½ pint.	½	2	Cotton waste, 1 pint.
2	Boiled linseed oil, ½ pint.	½	2	Cotton batting, 3 pints.
3	Boiled linseed oil, ½ pint.	½	2	Sawdust, 1 pint
4	Boiled linseed oil, ½ pint.	½	2	Kapok, 1 pint
5	Raw linseed oil, ½ pint.	1	4	Kapok, 1 pint
6	Safflower oil, ½ pint.	½	2	Cotton waste, 1 pint.
7	Safflower oil, ½ pint.	½	2	Cotton batting, 3 pints.
8	Safflower oil, ½ pint.	½	2	Sawdust, 1 pint
9	Safflower oil, ½ pint.	½	2	Kapok, 1 pint
10	Tung oil, ½ pint.	½	2	Cotton waste, 1 pint.
11	Tung oil, ½ pint.	½	2	Cotton batting, 3 pints.
12	Tung oil, ½ pint.	½	2	Sawdust, 1 pint
13	Tung oil, ½ pint.	½	2	Kapok, 1 pint

Note. The above quantities for each system are approximately correct for use in a 1 gallon confinement container. The impregnated combustible material should fill the container to approximately ⅓ to ½ the volume for best results. Different size containers can be used with properly adjusted quantities of impregnated combustible material. At approximately 70° F., delay time to ignition is roughly 1 to 2 hours. With

Fire Fudge or Fuse Cord added to the impregnated combustible material, delay time is reduced to roughly ½ to 1 hour. The exception to this is System 8 where delay time to ignition is about 2 to 3 hours. With Fire Fudge or Fuse Cord added, delay time is shortened to 1 to 2 hours.

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c. *Preparation.*

(1) *General instructions.*

(a) Measure the combustible material by tightly packing it up to the top of the one pint measuring jar. The material should puff out of the measuring jar when firm hand pressure is removed.

(b) Transfer the combustible material from the measuring jar to the container in which it is to be confined.

(c) Pour the vegetable oil into the one pint measuring jar to one-third jar volume.

(d) Using a teaspoon, add the specified quantity of Cobalt Drier to the vegetable oil in the one pint measuring jar. Wipe the spoon dry and add the specified quantity of Lead Drier to the Vegetable Oil—Cobalt Drier mixture.

(e) Thoroughly mix the combination of vegetable oil and driers by stirring with the teaspoon for approximately one minute.

Note. Vegetable oil and drier can be mixed and stored in an air-tight container for one week before use. Longer storage is not recommended.

(f) Pour the oil mixture from the one pint measuring jar over the combustible material in the container. Saturate the combustible material by kneading, pulling and balling with the hands. This can be accomplished either inside or outside of the container.

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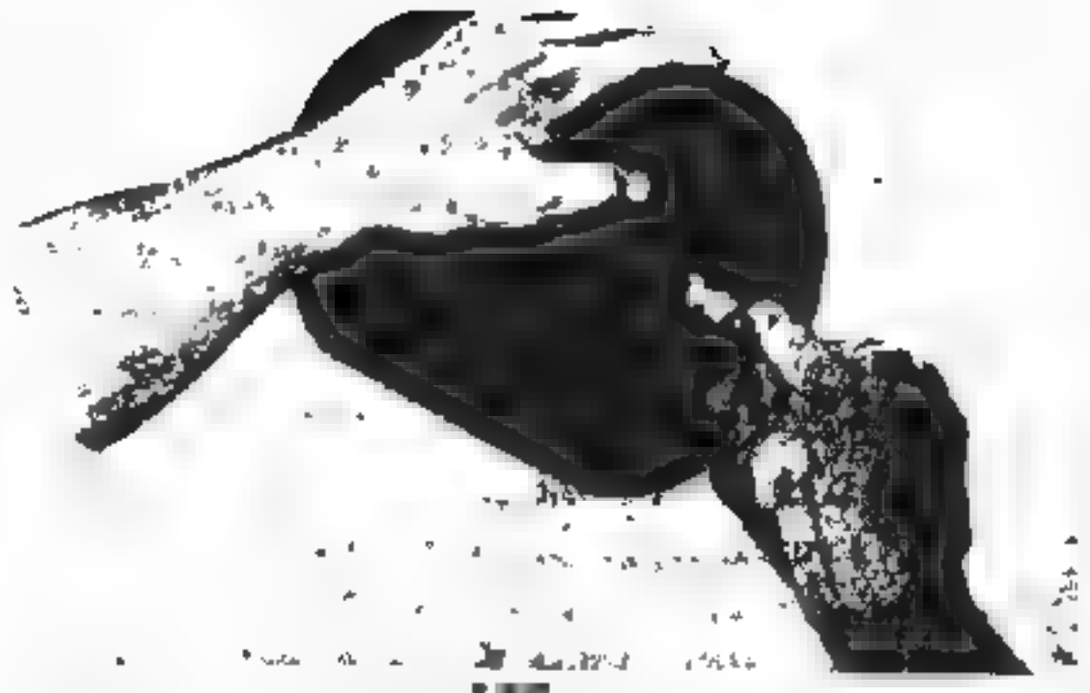
(g) Remove saturated combustible material from the container.

(h) Cut a hole with a knife, one to two inches in diameter, in the bottom center of the container.

(i) Place the container on a flat surface, hold the 1½-inch diameter stick vertically over the hole in the bottom of the container and pack the saturated combustible material



around the stick compressing it so that it fills ⅓ to ½ of the container volume after hand pressure is removed.

(j) Remove the stick. This leaves a ventilation hole through the center of the combustible material. The spontaneous combustion device is now ready for use unless the following optional step is taken.

(k) This step is optional. *Either* take a piece of Fire Fudge (0202) about the size of a walnut and crush it into pieces about the size of peas. Sprinkle the pieces of crushed Fire Fudge on top of the combustible

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material. *Or* cut a piece of Fuse Cord (0101) to a length of about four inches. Since safety fuse burns inside the wrapping, it is sliced in half to expose the black powder. (Lacquer coated fuse (nonsafety type) burns completely and may be used without slicing.) Insert one or more pieces of fuse vertically in the combustible materiel near the center vent hole, leaving about one inch extending out of the top surface of the

combustible material.

(2) *Preparation of improvised driers.* If the commercial driers (cobalt and lead) specified under *Material and Equipment* above are not available, the following improvised driers can be made using either flashlight batteries or powdered lead oxide (Pb_3O_4). These improvised driers are used in the same manner as the commercial driers.

(a) *Manganese drier.*

1. Break open three flashlight batteries (size

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D) and collect the pasty material surrounding the central carbon rod.

2. Put this material in a one-pint wide-mouth jar and fill jar with water.

3. Slowly stir contents of jar for approximately two minutes and allow contents to settle. The contents will usually settle in one-half hour.

4. Pour off water standing on top of settled contents.

5. Remove wet contents from jar, spread it on a paper towel and allow to dry.

6. Dry the jar.

7. Pour raw linseed oil into the one-pint measuring jar to one-third jar volume.

8. Combine the measured quantity of raw linseed oil and the dried battery contents from *5* above in a pot and boil for one-half hour.

9. Shut off heat, remove pot from the heat source, and allow the mixture to cool to room temperature.

10. Separate the liquid from the solid material settled on the bottom by carefully pouring the liquid into a storage bottle. Discard the solid material. The liquid is the drier.

11. The manganese drier is ready for use.

12. If manganese dioxide powder is available, flashlight batteries need not be used. Place one heaping teaspoonful of manganese dioxide powder into the raw linseed oil and boil the mixture in a pot for one-half hour. Then follow *9*, *10*, and *11* above.

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(b) *Lead oxide drier.*

1. Pour raw linseed oil into the one-pint measuring jar to one-third jar volume.

2. Combine the measured quantity of raw linseed oil and two heaping teaspoonfuls of lead oxide in a pot and boil gently for one-half hour. The mixture must be stirred constantly to avoid foaming over.

3. Shut off heat, remove pot from the heat source, and allow the mixture to cool to room temperature.

4. Pour the liquid into a storage bottle and cap the bottle.

5. The lead oxide drier is ready for use.

d. Application.

(1) The spontaneous combustion device is placed at the target on a flat surface with one edge propped up to allow ventilation through the impregnated combustible material.

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Since flames normally shoot up from the open top of the container, combustible target material should be positioned from three to five inches directly over the top of the device for satisfactory ignition of the target. *DO NOT COVER OPEN TOP OF CONTAINER.*

(2) Temperature of the environment in which these devices are used affect, the ignition time these devices are used affects the ignition time. The following table gives approximate time to ignition at different temperatures. However, it is recommended that ignition time be determined by advance trial.

Temperature (° F.)	Time to ignition (hours)
60–70	1–2
40–60	2–4
20–40	4–10

(3) Spontaneous combustion devices can also be improvised by stuffing impregnated combustible material into a pocket of any one of the following garments: coat, laboratory jacket, pants, or similar items. The combustible material stuffed in the pocket should be below the top of the pocket and should not be packed too tight.

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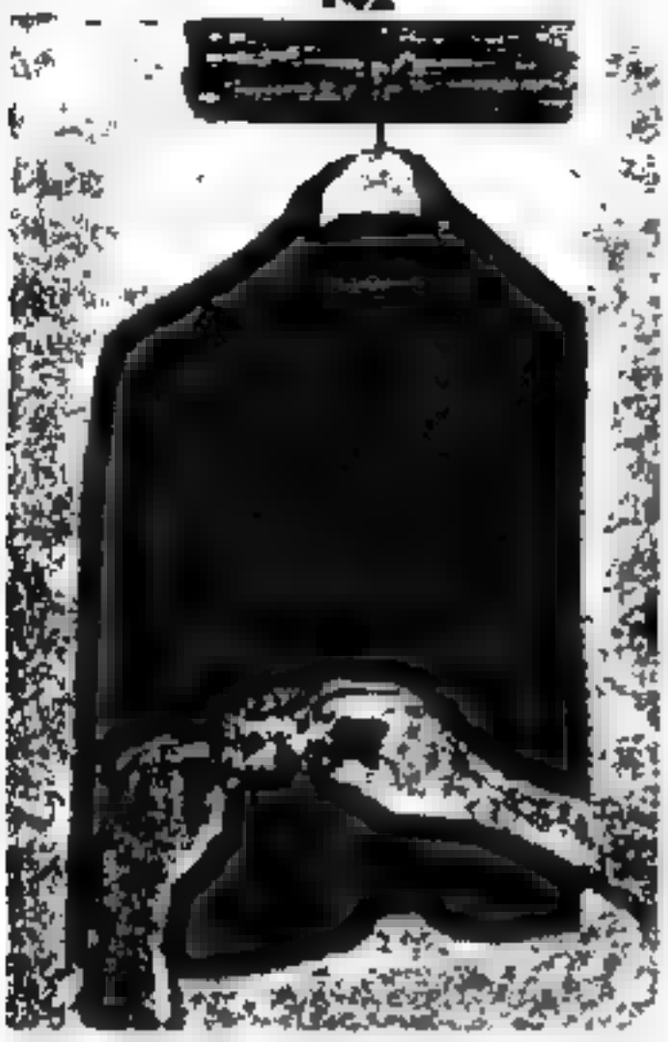

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IMPROVISED INCENDIARIES

General

Good incendiaries can be improvised more easily than explosives and the materials are more easily obtained. On a pound for pound basis, incendiaries can do more damage than explosives against many type targets if properly used. There is a time lag, however, between the start of a fire and the destruction of the target. During this period the fire may be discovered and controlled or put out. An explosive once detonated has done its work.

Incendiaries are cheap and little training is needed for their preparation and use. Used in very carefully excuted operations, the act of sabotage may be concealed in the ashes of an "accidental" fire

Fires may be started quickly and have reasonable chance of success if the following few simple principles are observed

1. See that there is plenty of air and fuel to feed the fire

2. Use an incendiary that supplies a prolonged and persistent heat

3. Start the fire low in the target structure and let it spread naturally upwards.

4. Use reflecting surfaces, such as corners, boxes, shelves, to concentrate the heat.

5. Use drafts to spread the fire rapidly — near stairways, elevator shafts.

6. Protect the fire from discovery during the first few minutes by good concealment and timing.

In preparing improvised incendiaries observe basic rules of safety Chemicals that must be powered should be ground separately with clean tools and then mixed in the indicated proportions. Chemicals or mixtures should be kept tightly sealed in jars or cans to protect them from moisture. Damp materials will work poorly if at all

Sulfuric acid, which is useful for chemical delays and to ignite incendiaries or explosive detonators, can be obtained by concentrating battery acid. This can be done by boiling off the water in the battery acid in a glass or porcelained pan until dense white fumes begin to appear. This operation should be done out of doors and the resulting concentrated acid should be handled carefully.

The paragraphs which follow will describe the preparation of several igniter (or "first fire") incendiary mixes, some basic incendiary mixes, and a thermate metal-destroying incendiary.

The subject of incendiaries has been treated much more exhaustively in other publications. The intent of this handbook is to provide only a few techniques.

Potassium Chlorate and Sugar Igniter

Chlorate-sugar is one of the best of the first fire or igniter mixes. It burns very rapidly, with a yellow-white flame, and generates sufficient heat to ignite all homemade incendiaries mentioned in this handbook.

MATERIALS: Potassium chlorate (preferred) or sodium chlorate, sugar.

PREPARATION.

1. Grind the chlorate separately in a clean, non-sparking (glass or wooden) bowl with a wooden pestle. the resulting granules should approximate those of ordinary table sugar.

2. Mix equal volumes of the granulated chlorate and sugar by placing both on a large sheet of paper and then lifting the corners alternately.

CAUTION: This mixture is extremely spark sensitive and must be handled accordingly.

3. Wrap 4 to 6 tablespoonfuls of the mixture in thin paper so as to form a tight packet. Keep the mixture as dry as possible. If it is to be stored in a damp area before using, the packet may be coated with paraffin wax.

Chlorate-sugar is easily ignited by the flame of a match, the spit of a percussion cap or time fuse, with concentrated sulfuric acid.

If ignited when under confinement it will explode like gunpowder. If it is contained in a waxed packet, therefore, the latter should be punched through in several places before it is used with a basic incendiary and ignited.

Flake Aluminum-Sulfur Igniter

This simple igniter burns extremely hot and will ignite even the metal-destroying thermate, described later on. The mixture itself can be lit by chlorate-sugar.

MATERIALS: Flake aluminum, finely powdered sulfur.

PREPARATION.

1. Mix 4 parts by volume of finely powdered sulfur with 1 part of aluminum powder.

To use, place several spoonfuls of the mixture on the material to be lit and add a spoonful of chlorate-sugar on top. Be sure the safety (time) fuse or other spark-producing delay system is placed so it will act upon the chlorate-sugar mixture first.

Homemade Black Powder Igniter

Black powder may be used for igniting napalm, flammable solvents in open containers, paper, loose rags, straw, excelsior and other tinder type materials. If it is not available already mixed, it can be prepared as follows.

MATERIALS: Potassium (or sodium) nitrate, powdered charcoal, powdered sulfur, powder

PREPARATION

1. Into a clean, dry jar or can put 7 spoonfuls of potassium or sodium nitrate, 2 spoonfuls of powdered charcoal, and 1 spoonful of powdered sulfur. The ingredients must be at least as fine as granulated sugar If they must be ground, GRIND EACH SEPATATELY. Never grind the mixed ingredients — they may ignite or explode

2. Cap the can or jar tightly and shake and tumble it until the ingredients are completely mixed.

The mixture will be effective for months if kept tightly sealed and dry. Sodium nitrate in particular has a tendency to absorb moisture.

To use the gunpowder, pile 2 or 3 spoonfuls on top of any solid incendiary material which is to be ignited. For igniting liquids in open containers, wrap 2 or 3 spoonfuls in a piece of paper and suspend it just above the liquid.

Gunpowder is best ignited by safety fuse It burns very quickly and with a great deal of heat, so allow sufficient time delay for safe withdrawal from the vicinity.

Match Head Igniter

A good ignition material for incendiaries can be obtained from the heads of safety matches, which are available almost any place The composition must be removed from the heads of many of them to get a sufficient quantity of igniter material. It will ignite napalm, wax and sawdust, paper, and other flammables

MATERIALS: Safety matches.

PREPARATION

Remove the match head composition by scraping with a knife or crushing with pliers. Collect several spoonfuls of it and store in a moisture-tight container.

Put at least 2 spoonfuls on the material to be ignited. To ignite liquids, such as solvents or napalm, wrap several spoonfuls in a piece of

paper and hang this just over the fluid, or place nearby. If fluids dampen the mixture it may not ignite.

Ignition can be by time fuse, firecracker fuse, a spark, or concentrated sulfuric acid.

Time Fuse Fire Starter

Several igniters or first fire mixes can be set off by a spark from time fuse. Others require a stronger flame. Time fuse, plus matches, can be combined to improve this more intense initial flame.

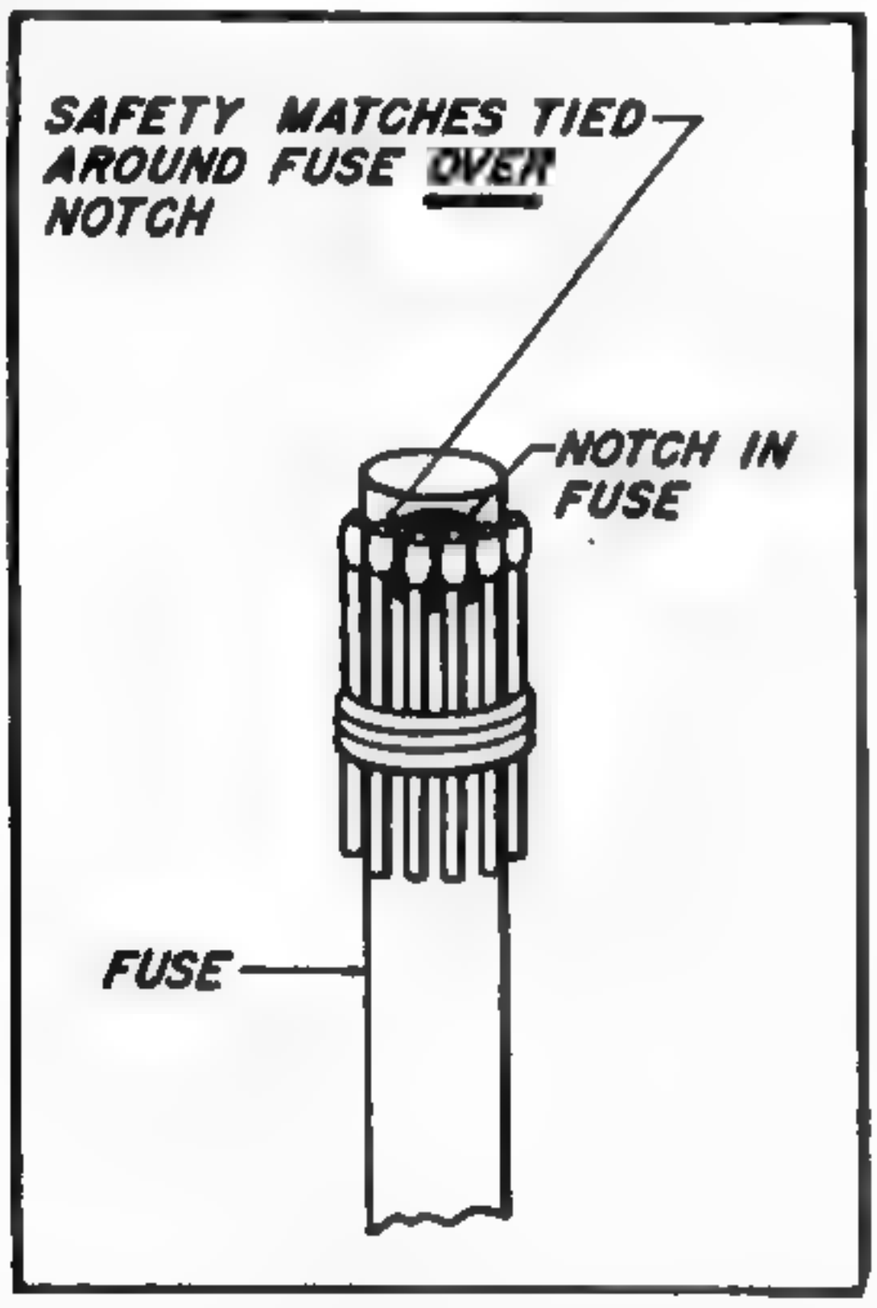
MATERIALS: Time (safety) fuse, safety matches, string or tape.

PREPARATION:

1. About ¼ inch from the end of a piece of time fuse cut a notch with a sharp knife so that the powder train is exposed.

2. Around the fuse at this point tape or tie several matches so that their heads are in contact with each other and at least one match head is directly over the notch. See Figure 59.

When the fuse burns down, a spark from the notch ignites the one match head, which flares and ignites the others. this fire starter can be inserted into an igniter mix or used alone to light crumped paper or excelsior. Another application, nonelectric firing of the 3.5" rocket, is described earlier.



Time Fuse Fire Starter

Homemade Napalm

Napalm is the best incendiary to use against most flammable targets. It will readily ignite paper, straw, flammable solvents, or wooden structures.

MATERIALS: Gasoline or fuel oil, nondetergent soap (bar, flakes, or powder)

PREPARATION.

1. Use about equal parts of soap and oil. If bar soap is used, slice it into small chips. If both gasoline and fuel oil are available, use both in equal parts.

2. Heat the fuel in an open container, preferably one with a handle, out of doors. Try to avoid creating sparks or having a high open flame, but if the fuel should catch on fire extinguish it by placing a board or piece of tin over the container

3. Gasoline, in particular, will begin to bubble very quickly. When it does, remove from the fire and gradually add the soap, stirring continuously, until the soap is completely dissolved and a thin pasty liquid results. If necessary return the mixture to the fire, but as a safety measure it is best not to stir while the container is on the fire.

4. When the desired consistency is reached allow the mixture to cool.

5. Napalm also can be mixed by a cold method, although it may take hours to thicken. This should be done by alternately adding very small

Molotov Cocktail

amounts of soap chips or powder and gasoline or fuel oil and stirring until the mixture reaches a thin jelly-like consistency. It is best to start with about a cupful of soap, add part of a cup of solvent and stir that until smooth before gradually adding the remaining ingredients Continuous stirring is not required. In fact, it is advisable just to let the mixture and the mixer rest from time to time and give the soap a chance to dissolve.

Napalm will keep well if stored in a tightly sealed container. It can be ignited with a match or any of the first fire mixtures described previously. The ignition packet should be placed adjacent to or just over the napalm, otherwise the petroleum may soak it and prevent its burning.

When napalm is used on easily ignitible materials (such as loosely piled paper, rags, or hay) it should be spread out so it will start a large area burning at once. Tightly baled paper or rags should be loosened first, because they do not burn well. If used directly against wooden structures or other large articles which are difficult to ignite, the napalm should be concentrated in sufficient quantity to provide a hot, long lasting blaze. If about a half dozen pieces of charcoal are put into and around the napalm the heat output is considerably increased.

Napalm makes an excellent "Molotov cocktail." Just fill any glass bottle with a small neck with the napalm and cram a twisted strip of cloth into the mouth of the bottle as a stopper. See Figure 60. When ready to use, pull about 4 to 6 inches of the rag stopper out of the bottle. Light the napalm soaked rag with a match and, when the rag is burning well, throw the bottle at the target. When the bottle breaks napalm spashes over the target and is ignited by the burning rag.

Paraffin-Sawdust Incendiary

Paraffin-sawdust is almost as effective as napalm against combustible targets, but it is slower in starting It is solid when cool and thus is more easily carried and used than liquid napalm. In addition, it can be stored indefinitely without special care.

MATERIALS: Dry sawdust, paraffin, beeswax, or candle wax

PREPARATION

1. Melt the wax, remove the container from the fire and stir in a roughly equal amount of sawdust.

2. Continue to stir the cooling mixture until it becomes almost solid, then remove from the container and let it cool and solidify further.

Lumps of the mixture the size of a fist are easiest to manage. The chunks of incendiary may be carried to the target in a paper bag or other wrapper. Any igniter that will set fire to the paper wrapper will ignite the wax and sawdust.

A similar incendiary can be made by dipping sheets of newspaper into melted wax and allowing them to cool. These papers may then be

crumpled up and used in the same manner as the paraffin-sawdust, although they will not burn as hot and persistently

Sawdust, Moth Flakes, and Oil Incendiary

This incendiary is very good for use against all kinds of wooden structures, including heavy beams and timbers. It also works well on paper, rags, straw, excelsior, and other tinder type materials. It will start fires in open containers of flammable liquids, piles of coal, coke, or lumber, and on baled rags and paper. It is not effective against metal.

MATERIALS: Dry sawdust, moth flakes (naphthalene), fuel oil (kerosene or diesel oil).

PREPARATION:

1. Place equal parts of sawdust, moth flakes, and oil into a container and stir until the mixture is the consistency of mush.

2. Store it in any container that will retain the oil fumes.

An easy, effective way to use this mixture is to put about a quart of it in a paper bag and place the bag on the target material. The bag can be lit with a match and the mixture will ignite quite readily. It burns as well as napalm. If a longer delay time is required, use one of the igniter mixes described earlier along with time fuse or other delay device. The time fuse alone, however, will not ignite the incendiary mix.

Where very large wood beams are to be burned, an additional amount of the incendiary will be required. Two or three quarts is enough to destroy almost any target against which the technique would be effective.

For the greatest effect on wooden structures, the mixture should be in a pile, never spread out in a thin layer. It should be placed beneath the target material, if possible, so the flames will spread upward. In a packing box or room, a corner is a good place to start the fire.

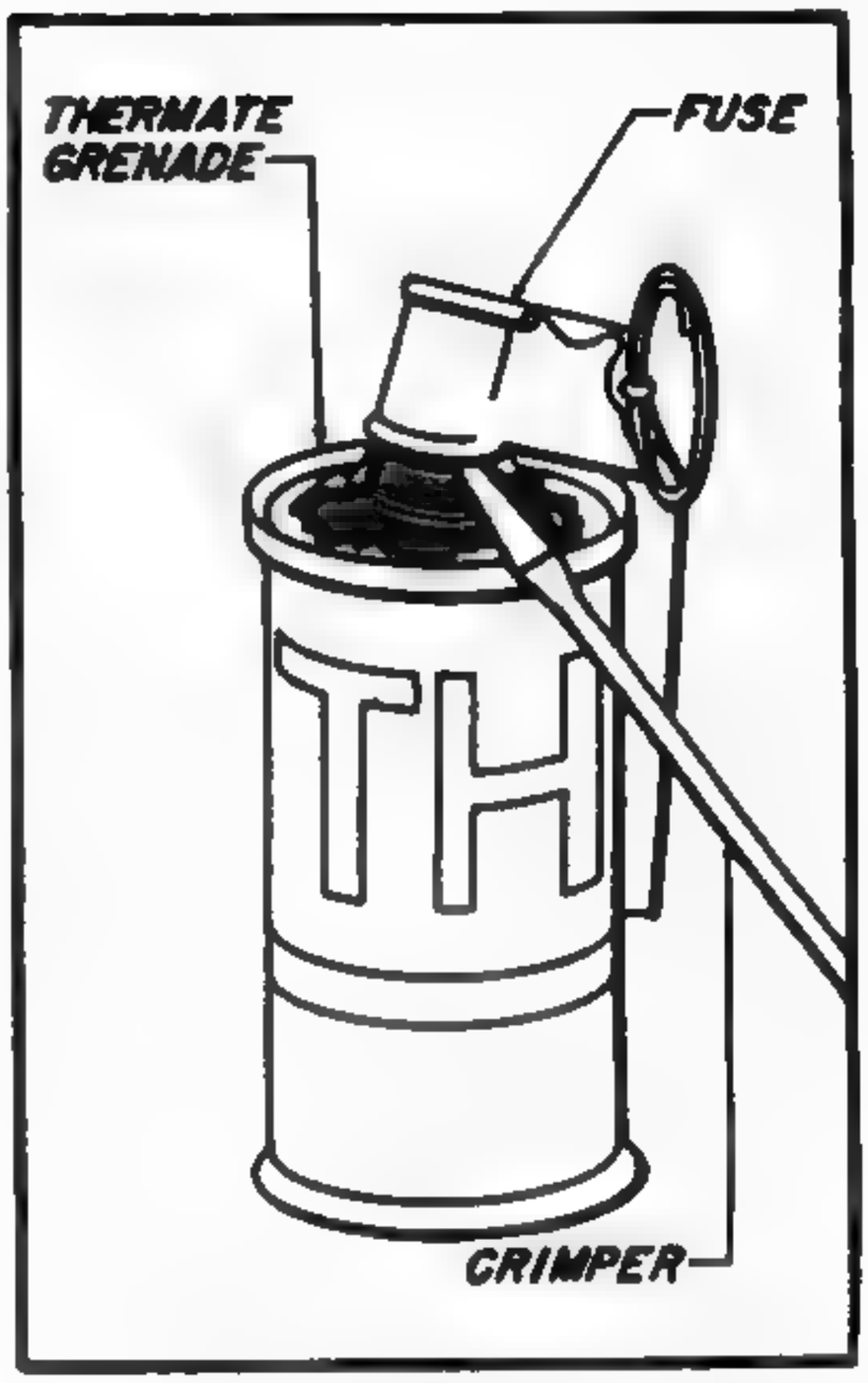
Thermate Incendiary

Thermate is similar to commercial thermit, used in welding, except that it also contains an oxidizer, making it easier to ignite. Thermate will readily burn paper, rags, excelsior, straw, and other tinder type materials. However, its main use in sabotage operations is against motors, gears, lathes, or other metal targets — to weld moving parts together, warp precision machined surfaces, and so on. Since it burns with a brief, almost explosive action, it is not recommended for burning wooden structures or other materials where persistent heat is required.

A good source of ready-made thermate is the U.S. military AN M-14 Incendiary Grenade. To remove the thermate, first pry out the fuse assembly with crimpers or other nonsparking implement. See Figure 61. The reddish-brown caked substance on top of the contents of the grenade is a first fire mixture and it is spark sensitive. This should be broken up and the grayish powder beneath, which is the thermate, can be poured out.

Thermate also can be made from aluminum or magnesium powder and a chemical oxidizing agent, as described below:

MATERIALS: Aluminum filings, powder or flakes, or magnesium filings or powder, plus any one of the following chemicals: potassium nitrate, sodium nitrate, barium nitrate, potassium dichromate, sodium dichromate, or potassium permanganate. Although aluminum and magnesium are equally effective, thermate made from magnesium is easier to ignite. Flake aluminum, which is the extremely fine variety used in paints, is excellent. In any case, both the metal and chemical ingredients should be no coarser than granulated sugar.



Defusing Thermate Grenade

PREPARATION:

1. Fill a quart size (or larger) container about 2/3 full of equal parts of the metal powder and the oxidizing agent.

2. Cover with a tight lid, then roll and tumble the container until the contents are completely mixed.

3. If flake aluminum is the metal used, fill the container ½ full of the aluminum then add oxidizing agent until the container is ¾ full. Mix as described above.

Thermate in a sealed container can be stored for months. To use, put 1 or 2 pounds of the mixture in a paper bag and place it on the target in such a way that when it burns the red hot molten material will run down and attack the vital parts.

Chlorate-sugar and aluminum-sulfur igniters are best for setting off thermate, particularly if the thermate contains aluminum powder, which is more difficult to ignite.

Thermate also is used in the improvised dust initiator and the external POL charges described later.

More On The Ultimate Booby Trap

by KURT SAXON

For awhile I believed I had discovered the more interesting aspects of ammonium nitrogen tri-iodide or ANTI. But as I talked to others in the field I found that ANTI has been used in one form or another by many others. I will take credit for publisizing it, however.

One military trainer in improvised weaponry told me of a case where someone forced ANTI into a lock. When the victim put his key into the lock, the ANTI exploded with such force that it drove the key through his hand. So don't consider ANTI as something just for practical jokes. Although it does lend itself to practical jokes, it is a high explosive. So either save it for the Russians or or use it in tiny bits.

So many have written in about it that I've decided to sell a starter kit so you can experiment before stocking up. The kit contains one ounce of iodine crystals, a vaccine bottle holding 10 ccs of strong ammonia, a 3 cc hypodermic needle, a zip-lock bag with a folded piece of blotting paper and a desiccant cannister.

In case you don't know what a desiccant cannister is, it is a small, plastic cannister with moisture absorbent put into medicine bottles.It has little bitty holes in both ends. To use it, press Scotch tape over the holes.

To make small batches of ANTI, open the cannister with a finger nail and put in enough iodine crystals to make it one quarter full. With the hypo, withdraw 1 cc

of strong ammonia and squirt it in the cannister and put the lid on. After from 20 to 30 minutes, remove the lid and dump the contents on a few layers of newspaper. After a few minutes the paper will draw off most of the liquid. Now take a knife and move the pile of ANTI to a dry spot and cut it into small bits.

Remove the blotting paper, wet it and then mash it on newspapers so it will be simply damp. Put the bits of ANTI on one section and fold the other section over it and put it, bent end first, into the zip-lock plastic bag and fasten it.

This will keep the ANTI moist and safe for several hours or even days. The worst thing that could happen would be that it would go off in your pocket. That might be a shock but not injurious. If it should really dry out in your pocket and you believe it might go off when you open the blotting paper, better to flush it down the toilet. At any rate, always wear glasses when dealing with ANTI. Although its blast radius is about a half inch, it can send tiny bits of debris which could cause eye damage.

If you like a laugh, take the ANTI into a bar, theater or other dark place. In the john, open the blotting paper and scrape the bits of ANTI loose. Then go where the people are and scatter the bits around on the floor

Within a half hour or so the bits will begin going off on their own or after being stepped on. It will sound like firecrackers or gunshots, depending on the size of the bits. After a few bangs the place will probably be cleared out and the area cordoned off by the cops.

A really sinister use for ANTI is for blowing up vehicles. I suggest this only for enemy vehicles and I trust no reader of my works would be so demented as to use it on fellow Americans.

The idea is to put a piece of moist ANTI in a lid from a desiccant cannister without the holes being stopped up, as they would be while making the ANTI. A piece of paper of the same size is glued over the opening and some glue is smeared on the paper side. Then the glued side is pressed up inside the gas intake of an enemy vehicle.

When the ANTI dries and is disturbed by the vibration of the moving vehicle, it will ignite the fumes in the gas tank with devastating results.

The same device is reccommended for any powder bomb. As the drying ANTI contracts, the powder will shift around it, setting it off prematurely, if the object is for the weapon to go off while being handled or in a moving vehicle. The desiccant cannister lid with the paper glued over its open side will protect the ANTI from shifting powder.

Because of the ammonia, this cannot be mailed so I'll need a delivery address. Its cost is $15.00. There is enough ammonia for several batches. I won't sell ammonia seperately since you can distil your own simply with the homemade still described in the page 99 of the PMJB Vol. 1.

AMMONIUM NITROGEN TRI-IODIDE "ANTI" "RATAWAY"

ANTI KIT: As described in issues 1 & 3 of SURVIVOR 6, ANTI is the most unstable fulminate known. As a starter kit I will sell 1 oz. iodine crystals, enough strong ammonia to make up to fourteen batches, a hypodermic needle to measure 1 cc of ammonia into the dessicant cannister holding 1/3 its volume of iodine crystals, plus a carrier composed of a zip-lok plastic bag with a folded piece of blotting paper.

To make, put Scotch Tape over holes in each end of the dessicant cannister. (Use epoxy to close holes permanently). Put in 1/3 volume of iodine crystals and 1 cc of strong ammonia. Push on cap and let stand 20 to 30 minutes. Open and tamp contents onto several layers of newspaper. When most of the moisture has been soaked up by the paper, scrape the ANTI over to a dry area, separate into small pieces and lay on slightly dampened blotting paper. Fold the blotting paper and put it, open end up, in the zip-lok bag. Caution: when dry it explodes. $15.00

THE

GUNSMITH'S MANUAL;

A COMPLETE HANDBOOK

FOR THE

AMERICAN GUNSMITH,

BEING A

PRACTICAL GUIDE TO ALL BRANCHES OF THE TRADE.

By J. P. STELLE and WM. B. HARRISON.

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CHAPTER I.

HISTORY OF THE GUN.

Discovery of Gunpowder.—No authentic records have been left to show when or by whom was discovered the wonderful properties of the chemical compound now known as gunpowder; nor have we any information concerning the uses to which it was originally applied. There is little probability that it was at once employed as an agent in fire-arms; indeed, we have pretty strong evidence to show that it was not, for Roger Bacon refers to it in his famous treatise, *De Nullitate Magica*, published A. D., 1216, while fire-arms are mentioned by no writer as having been known earlier than about 1338.

The First Fire-Arms.—The first fire-arms, or guns, as we now call them, are said to have been rude cannon, formed by banding together flat iron bars, something on the plan of our wooden casks or barrels of to-day. These guns were fired with a "slow match," the gunners retiring to a safe distance while the match was burning to the priming. Their earliest use was as engines of war. The writers of ancient history tell us that they were so employed by the Moors at the noted siege of Algesiras, Spain, in 1341, and at the battle of Calais, in 1346. At the latter battle, Edward III is credited with having had four pieces, which made him victorious.

Earliest Hand-Guns.—It is claimed by Spanish historians that to Spain belongs the honor of having been the first power to furnish her soldiers with fire-arms so small that they could be transported by a single person. They were unwieldy affairs at the beginning, however; really small cannon lashed upon wooden scantlings. The soldier could not fire his piece off-hand, but was forced to carry a "rest" with him wherever he went. Being ready to discharge his arm he balanced it upon the rest, steadied it by holding the scantling under his arm, and then "touched it off" with a live coal of fire, while he sighted along the barrel to take aim at his object. What happened immediately after the coal came in contact with the powder the historian saith not, but a modern writer, who has been examining one of these old guns in a museum, jumps to the conclu-

sion that the soldier, with the scantling under his arm, must have been launched suddenly into an impressive dream of first-class earthquakes, or something else "like unto the combined kicking of about fifty mules."

Prejudice Against Fire-Arms.—For about two centuries after the invention of hand fire-arms they were so inefficient that the cross-bow, then in general use, was able to quite successfully hold its own against them. It was not until 1596 that Queen Elizabeth, by a proclamation, directed that cross and other bows used in the army should be discarded entirely in favor of muskets. And thereat there arose much murmuring of dissatisfaction throughout the English Empire, according to Michael Montaigne, a most prominent man of his time, who narrates the fact, and adds: "Except the noise in our ears, to which we will be henceforth accustomed, I think the fire-arm is one of very little effect, and I hope that we shall one day give up its use." Could he return to earth at this age, and see the wonderful fire arms that have developed from the humble beginning of which he was then treating, he would speedily lose his hope to the effect that one day its use would be entirely given up.

The First Rifle.—The first rifle is said to have been made about the close of the fifteenth century, by one Gaspard Zollner, of Vienna. It was a simple barrel with straight grooves; the only object of the grooves being to prevent its becoming so "dirty" from continued use, as did the smooth-bore. Spiral grooving does not seem to have been thought of until many years later

The Arquebus.—The earliest noted improvement in the hand-gun, making it lighter and giving it a longer barrel, was called the arquebus; but even this was so heavy that a "rest" was necessary while discharging it. This rest was a single staff armed with a steel point which went into the ground like the Jacob-staff of a surveyor, but which fitted it for use as a pike when not employed in connection with the gun. It was called the *schweine feder*, which rendered into English means the "hog's bristle."

The arquebus was a regular "match-gun;" that is, it had a "pan" or receptacle at the side of the breech for the priming powder, which communicated with the interior of the barrel by a small perforation called the "touch-hole." The priming was lighted by a match, which consisted of a coil of small rope saturated with some kind of chemical, which caused it to burn readily and hold fire for a long time. The soldier using the arquebus carried the match in his hand and kept it buring during an action. The manner of setting off the piece was about the same as with the live coal—he secured his sight and then touched the priming with his lighted match

The Match Lock.—Later, the serpent-match was invented and looked upon as a startling improvement. It was a simple S-shaped piece of iron or wire hinged to the side of the gun just back of the priming pan. The upper end was provided with a beak

which gripped the lighted fuse, while the lower end played the part of a modern trigger. With this contrivance the gunner had only to take sight and then pull with his finger upon the lower end of the S until the lighted fuse was brought down into the priming. After many years of use an improvement was made upon the S, consisting of a small spring which threw it back into an erect position so soon as the pressure upon the lower end was discontinued.

The powder employed with the old arquebus was of two grades as to size of grain; a coarse grade for the charge, and a fine grade for the priming. Its chemical composition does not seem to have differed materially from that of our modern gunpowder.

The serpent match, so called because the upper end holding the fuse was often shaped to represent the head of a serpent, was the first actual step taken towards a gun-lock. It was thought to be perfection itself, especially after the returning spring had been added, and so strong a hold did it take upon all nations that only a few years has elapsed since it was wholly abandoned in some of the most benighted regions, as in China, for instance, where it is known to have been used in the army at a date as late as 1860.

Musket-Petronel.—Next in order to the arquebus came the musket, a Spanish invention. It was heavier than its predecessor, and carried a charge twice as large. Almost simultaneously with this appeared the first cavalry fire-arm, which was called the petronel. It was shorter than the musket and larger in bore; the horseman rested its breech against his breast and communicated the fire by means of the serpent match.

The Wheel-Lock.—In 1517 the Germans astonished the world by inventing and bringing into use the "wheel-lock," which was a regular gun-lock, entirely doing away with the lighted match. It consisted of a small disk of steel fluted on the edges, set in close contact with the priming pan, and made to revolve with great rapidity by means of a spiral spring arranged somewhat on the plan of the spring of a spring-clock. In contact with its fluted edge, and held there by a spring, was arranged a sharp flint; hence when the steel disk was set in motion a train of sparks was thrown off as it revolved over the edge of flint. These sparks fell into the priming pan and ignited the powder, discharging the piece. The spring was wound up like winding a clock or watch, and a slight pressure upon a trigger under the breech set the wheel in motion. The pressure was continued until the gun was discharged, when it was discontinued, the result of which was an immediate stopping of the wheel. A single winding would usually discharge the gun about half a dozen times.

The Pistol.—The wheel-lock went into quite general use, finally leading to the invention of the pistol, about 1544. The first pistols were single barrel, and very short. The stock was heavy, and the breech or handle, instead of leaving the barrel with a curve, as in later days, dropped at right angles to the iron. It was put into use as a cavalry arm, first by the Germans and afterwards by the people of many other nations. In 1607 the German horse soldiers were all regularly armed with double-barrel wheel-lock pistols.

The Snaphaunce.—After the date just mentioned modifications and improvements in fire-arms were rapid and constant. The wheel-lock was finally followed by the "snaphaunce," which was a straight piece of furrowed steel brought to bear upon the flint instead of the disk. It was more simple in its construction than the wheel-lock, and hence less liable to get out of order. Of course it worked in obedience to the action of a spring, but the spring was not a spiral—it was more on the plan of the mainspring in modern gun-locks.

The Flint-Lock.—About 1630 Spain again popped to the surface; this time with the regular flint lock, embracing precisely the same mechanism as the flint-lock used in our Revolutionary war, and familiar to very many of the older people of the present day. Its advantges over the wheel-lock and the snaphaunce were so marked that France at once adopted it for use in her armies, but England held back, contending that the wheel-lock was the better invention, till 1690, when she gave up the contest, and adopted the flint-lock.

Important Improvements.—Rapidly following the invention of the flint-lock came important improvements in the musket. The stock was lightened and put into better shape, and sights were invented and placed upon the barrels. Up to this time the soldier had been forced to carry his ammunition in bulk, but now cartridges were brought into use, carried in convenient and neatly made cartridge-boxes. Steel bayonets to set over the muzzle of the gun also appeared, the first in 1608. Prior to this time a rude kind of bayonet had been more or less in use—it was a sort of dagger set into a wooden handle, the latter to be thrust into the muzzle of the gun in case of a hand-to-hand charge, where loading and firing could not be attended to. Iron ramrods took the place of the inconvenient and unsafe wooden ones formerly in use, which was regarded as a long stride in the efficiency of the musket. With the old wooden ramrods, clumsy and easily broken, the loading of a musket was a slow and laborious task, but the iron rod secured comparative ease and rapidity.

Advance of the Rifle.—With the general improvement of fire-arms the rifle had worked gradually into favor and use. Its main drawback, as an army gun, laid in the difficulty experienced in loading it. But it was admirably adapted to the wants of the people settling the wilds of the American continent, hence they adopted it almost to the entire exclusion of any other kind of fire-arm. In the armies its use was limited to a few corps of sharp-shooters, usually on the frontiers where it was advantageous to harass the enemy by picking off his men at long range. England seems to have been rather prejudiced against the rifle until after our war

with her for Independence. In that war she appears to have had so striking a demonstration of its efficiency that she soon after adopted it as a military arm; and other nations, having faith in her superior judgment, finally followed her example, bringing the rifle rapidly upward in rank as an effectual implement of war.

The Percussion Lock.—In 1807 a Scotch clergyman by the name of Alexander Forsyth, invented a new method of igniting the charge in fire-arms, which, after various changes and improvements, settled down to what is now known as the percussion cap. The percussion lock was a simultaneous invention, of course; though it did not differ materially, in point of construction, from the old flint-lock already in use. The main difference consisted in the substitution of a cylinder and tube for the priming pan and frizzen, and a hammer for the cock.

A strong current of prejudice set at once against the percussion lock, though nobody could tell why. All declared it would not do, but none attempted to give a reason for the faith that was in them. As a result the new invention was pretty effectually held in the background until 1834, when its opponents accepted a challenge for a public test of its merits against those of the flint-lock. The test extended to 6,000 rounds. In the course of these the percussion lock (afterwards more commonly known as the cap-lock), gave but six mis-fires, while the flint-lock scored nine hundred and twenty-two misses.

This astounding defeat at once sealed the fate of the flint-lock; still it was a long time before the prejudice existing against the other could be entirely removed. Even as far down as the date of our Mexican war, General Scott flatly objected to its use in his army, and had his men armed with the flint-lock, although there were then in our arsenals percussion-lock muskets enough to have armed all his forces more than twice over.

But facts are such stubborn things that even the strongest prejudice must give way to them sooner or later. So it proved in this instance; one by one the manufacturers of flint-lock fire-arms adopted the improvements resulting from the discoveries of the Scotch clergyman, until finally no more flint-locks were made, and the percussion lock was in undisputed possession of the field.

The Breech-Loader.—When the percussion-lock had been fully adopted by the public, and all the "latest improvements" had been added to it, people thought that the fire-arm had attained to such a degree of perfection as to preclude any further change in the future; but how mistaken! The fate of the percussion-lock is now as much sealed as was that of the flint-lock at the test-trial of 1834. It is going the way of all its predecessors, and its entire extinction is only a matter of time. The breech-loader, with charge and ignition combined in the same cartridge, is rapidly taking its place, and, until some new and wonderful discovery comes to the surface, must, undoubtedly, stand paramount as the gun of the future.

While springing into general favor at one leap, as it were, the breech-loader is no new and sudden appearance. In truth it is of great antiquity In the Tower of London, the Woolwich Museum, and in the Museum of Paris, may be seen hundreds of breech-loaders that were made centuries ago. Of course they were not made to use the percussion cartridge peculiar to many such guns of modern make, nevertheless they were veritable breech-loaders, and the real suggestors, no doubt, of the modern arm of that character.

In the Museum of Artillery, at Woolwich, there is a breech-loading pierrier, or paterera, of the time of Edward IV. (1471). It consists of a directing barrel, terminating in a square bar or frame of iron, and a separate loading chamber, with handle, which was fastened in its place for firing by an iron wedge. There are also found in the museums many breech-loading pistols, that were evidently in use about cotemporaneous with this gun.

The records kept at St. Etienne, France, show that the French monarch, Henry II, shot with a breech-loading gun in 1540. And the English records show that the Marquis of Worcester took out a patent in that country for a breech action on the "cut-screw" principle in 1661. A portion of the specification reads as follows:

"An invencione to make certain guns or pistols which in the tenth part of one minute of an hour may be re-charged; the fourth part of one turne of the barrell, which remains still fixt, fastening it as foreceably and effectually as a dozen slirils of any screw, which, in the ordinary and usual way require as many turnes."

There are several specimens of the breech-loader made on this plan, now in the Woolwich Museum. There are also other specimens, on a plan entirely different, made at a date but a little more recent, for it seems that then, as in modern days, one invention was very apt to suggest another. Three years after the Marquis of Worcester had taken out his patent, one Abraham Hill, of London, patented some six different systems of breech-loaders. In his specification concerning one of them he says:

"It is a new way of making a gun or a pistoll, the breech whereof rises on a hindge, by a contrivance of a motion under it, by which it is also let down and bolted fast by one of the same motion."

This, as will be readily seen, was rubbing pretty close upon the breech-loader of the present day.

Since the dates of the patents just referred to, the breech-loading fire-arm is known to have been in uninterrupted existence; but so strong was the current turned against it by popular prejudice, that it was little known to the people in general. A want of scientific training among the masses was the cause which held it back; they were unable to clearly understand all the whys and wherefores connected with its workings, and, therefore, rejected it on the plea that it was dangerous, without really

knowing whether it was or not.

Great improvements in the breech-loader now succeeded each other with astonishing rapidity up to the time when M. Lefaucheux, of France, capped the climax by inventing the cartridge containing within itself the cap, or means of igniting the charge. This made it available as a sporting gun, and hence promptly set it forward into public attention; and finally, after a score or so of improvements, usually at the hands of the English, into public favor. It is, at last, the gun of the period, and the old muzzle-loader, with all its good qualities (and they were certainly many), is rapidly surrendering the field to the more successful candidate, and retiring in the footsteps of its honored predecessors, the wheel-lock and the flint-lock.

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CHAPTER II.

HOW GUNS ARE MADE.

Gunsmith—Gunmaker.—The modern gunsmith is not necessarily a gunmaker, but rather a repairer of guns that have happened to get out of order. In earlier days the devotees to his calling may, in their little shops, have made guns entire, but now, if the gunsmith *makes* them at all, that making consists in merely finishing up the parts and putting them together—generally making the stock entire. All gun parts can now be bought as "gunsmith's materials," either finished or in the rough, as may be desired. They are made by a variety of workmen, the business of each man being to make a single part, and nothing more. There is at present too much in a good gun to admit of all being made advantageously by one man; he would need to be a kind of "Jack-of-all-trades," and, like the traditional Jack, it is but reasonable to suppose that he would be really first-class at none.

In some of the large establishments where guns are made all these different workmen are employed, hence such an establishment is really a collection of workers in many trades. The gunsmith who has his shop for repairing purposes, or for putting together materials under the name of gunmaking, will not be specially concerned with reference to any of these trades, still it is but reasonable to suppose that he would like to know something of how the implements, or parts of implements, that he will be constantly handling, were put up; and, besides, there will exist something akin to a necessity for his possession of such knowledge, owing to the fact that his customers will often call upon him to answer many a question as to how this or that gun was made, etc. With this view of the case, it is really necessary to give a brief outline of gunmaking, following the work from the rough material to the final finish.

Gun-Barrels—Best Materials for.—The barrels of the finest and best guns, either Damascus, or other steel, or iron, are formed, as made in Europe and England, of scraps of iron suited to the purpose, and selected with great skill and the greatest possible care. These scraps, which are usually bought up about the country, are placed in what is called a "shaking tub"—a vessel which is violently shaken and rocked about by machinery or otherwise (depending upon the particular locality) for the purpose of scouring and brightening the scraps. This done, they are carefully picked over by adepts, who cull out the unsuitable pieces. So rigid is the culling that it often happens that out of a ton of scoured scraps not more than one hundred pounds weight of them are chosen as suitable for going into the best barrels.

Among the scraps usually thought to be best are old chains that have been used for many years, the wear and rust of time having left only the best elements of the iron. The Damascus steel, which has attained to so high a reputation, got it by being manufactured out of old coach springs. Of course it is not all made of coach springs now, but it was in years ago; agents then traveled all over the country hunting and buying them up, paying a much higher price for an old broken spring than a new one would cost its owner.

On Making Gun-Barrels.—The selected scraps to be worked into gun-barrel material are cut into small pieces and thrown into a furnace, where they are exposed to intense heat until fused, after which they are brought forth an adhering mass and placed under a hammer, which drives them together and forges them into bars. The bars are next rolled into thin plates, and then cut into strips twelve inches long and six inches wide. The *very best* guns are made of a combination of iron and steel. Both materials having been rolled and cut into sheets of exactly the same size, these sheets (one-fourth of an inch thick) are piled upon each other alternately to the number of thirty, and subjected to a welding heat; they are then driven together under a five-ton hammer into a consolidated slab. The slabs so formed are next worked down into one-fourth inch square rods. The more the material is hammered and worked the better it is. The rods are next twisted until they present the appearance of a strand of rope, some rods being twisted to the right and others to the left. Two rods, with opposite twist, are heated to the welding degree, placed upon each other, and rolled together; they are now in a narrow slab, presenting that fine curl of "grain" peculiar to the Damascus, or that beautiful wavy figure peculiar to the laminated steel, as the case may be. The next operation is to coil one of these slabs around a mandrel in a spiral form, and weld it securely under the blows of hand-hammers. It is now a gun barrel in the rough

Finishing and Proving. The rough barrel goes from the welder to the borer, where it is put through

the process of "rough boring." From the "rough borer" it goes into the hands of the "fine borer," who bores it out smoothly and to near the size it is to be when finished. Another operator then takes it in charge and dresses it to smoothness externally, then the "tester" takes it and dips it into strong acid, which soon shows any imperfection in either twist or welding that might exist. If not perfect, it is sent back to be worked over; if all right, it passes to the next department, where it is straightened inside. This part of the work is governed entirely by the eye, and hence demands the services of a workman of great skill, and experience.

Having been "passed on" by the "straightener," the barrel goes to the "turner," who turns it in a lathe until the outside is true and correspondingly straight with the interior, and is of exactly the requred weight. If the arm is to be a double-barrel shot gun, the barrel next goes into the hands of a workman who joins it to another barrel with the utmost nicety; to attain which, levels and other suitable instruments are brought into requisition. Like the man who straightens the bore, the man who joins the barrels must be a workman of great skill.

The next operation is to braze on the "lumps;" then, next in order, the ribs are put on. Now comes the "proving." The rear ends having been securely plugged, they go to the proof department, where is placed into each barrel fully four ordinary charges of gunpowder; then, atop of this, a wad of strong brown paper, rammed securely down, then a leaden bullet large enough to exactly fit the bore, and then another wad of brown paper. The charge is fired, and if the barrels stand the ordeal unfazed, they are ready to be fitted to the action; otherwise, they go back to be worked over. In some houses the "proving" is done before the barrels are joined together.

Action, Stock and Final Finish.—The "action man" now takes the perfect barrels in hand and performs his part of the work. In the meantime the stock-maker has not been idle. A stock is already in waiting, and next must come a series of fittings of the most exquisite nicety, until the gun is actually a gun and ready for its final test. This is applied by the "targeteer," who passes upon it according to its merits. If his report comes in favorable, the gun goes to the proper department for final finish. The stock is dressed up, finished in oil or varnish and chequered, and its mountings put on.

Every piece of metal is polished and burnished to the highest possible degree, and all the needed engraving is done. Next comes the case-hardening, coloring, and the browning or bronzing; and this having been well and satisfactorily performed, the gun is ready for market.

On Making the Rifle.—The processes employed in making the modern rifle do not differ materially from those named in the foregoing. Of course there are some processes employed on the shot gun that are not called for in the manufacture of the rifle, and some on the rifle not needed on the shot gun. The general principle is the same, however, and therefore it is not necessary to consume time in further description. The great care mentioned is only done to make a good gun; only the cheap and inferior guns are pitched together in an easier and more irregular way. But the gunsmith would not thank any one for a treatise on cheap and bad guns. They are legion, more's the pity, and his extensive dealings with them will afford annoyance sufficient to do away with any desire on his part to fight his battles over in a book.

Plain Steel-Barrel Guns.—Of course there are guns with "plain steel barrels," as they are called, which pass muster as fair; and the barrels of these are made by a process differing materially from that described in the foregoing; all else connected with the making is the same. These plain steel barrels are made of round bars of steel two inches in diameter. The bars are first cut into lengths of nine inches each; a hole or bore three-fourths of an inch in diameter is drilled through the centre. They are now called moulds, and the next step is to pass them through rolls, which reduce them to the required size for barrels and stretch them out to the required length, holding them, at the same time, in the proper shape, externally. Having been thus rolled, they are bored out internally, turned and ground externally, until they have attained to the shape and proportions of correctly formed barrels. After this comes the fitting up and "proving," as in the case of the finer guns.

CHAPTER III.

Guns Now in Use.
Gun Defined
The Old Flint Lock Gun
The Percussion Lock Gun
On the Muzzle Loaders
The Breech Loaders
Variety of Breech Loaders

CHAPTER III.

GUNS NOW IN USE.

Guns Defined.—Excepting the pistol, and the mortar, perhaps, all fire-arms now in use are classed under the name of guns. The cannon or artillery ordnance in all its sizes and forms, is simply a large gun. It is variously divided off, according to character, into heavy siege guns, field-pieces, rifled-cannon and smooth-bores. These again are sub-divided into a large number of different kinds, as the Armstrong, the Dahlgren, the Columbiad, the Paixhan, the Parrot, the Whitworth, etc. But with guns of this class the practical gunsmith will have nothing to do, and hence it is but reasonable to suppose that he feels no particular concern about them. It is with the small-arms that his concern will mainly be, and therefore from this page to the conclusion of this work the gun mentioned will be some instrument classing with the small fire-arms, and liable to be brought to a gunsmith's shop for repairs.

The small arms, or hand guns are muskets, rifles, carbines, fowling-pieces and pistols. These may be properly divided into three classes: the flint-lock, the

percussion-lock and the cartridge breech-loader

The Old Flint-Lock Guns.—Of the old flint-locks, only a few are now in existence within the United States. Here and there one has been kept as a kind of heirloom by some family, and occasionally these drop in upon the gunsmith for repairs, but not often. They are more common along the Mexican border in Texas, perhaps, than in any other portion of the country.

A minute description of the old flint-lock-gun need not be given, as, in general characteristics it does not differ materially from all other muzzle-loaders. The barrel is usually longer than that of the more modern gun; and, in the case of the rifle, the stock (all wood) extends nearly to the muzzle. It is what, in later days, when half stocks had been invented, was called a full-stock. As already intimated the interior mechanism of the lock differs very little from that of the more modern cap or percussion-lock. On the outside, in place of the cap-hammer is a cock arranged with two lips for holding a flint. The lips are brought together firmly upon the flint by means of a screw which passes down immediately back of it. In the top of the lock-plate, directly in front of the cock, is set the priming-pan; a small iron receptacle made to contain, say the fourth of a teaspoonful of gunpowder. When the lock is in position the butt or open end of the pan comes squarely up against the barrel of the gun where a small hole called the "touch-hole" communicates with the interior, and with the charge, when the gun is loaded. Over the priming-pan a cover fits nicely, lying horizontally when the pan is closed, and turning up at right angles on the edge nearest the cock, and standing erect, a small plate of steel, immediately in front of the flint. This cover, with its vertical plate is called the frizzen. It works on a hinge, and is held into whatever position set, by means of a small spring called the heel spring. When the cock is set in motion by drawing upon the trigger and releasing the check to the mainspring, the flint comes in contact with the steel plate of the frizzen, throwing it back upon its hinge and scraping down its face directly towards the priming-pan. As the frizzen flies back the pan is uncovered, of course, enabling the flint to end its journey directly in the priming powder of the pan. In its scrape over the steel plate of the frizzen it causes many brilliant sparks of fire, which descending with it into the priming sets off the charge.

The Percussion-Lock Gun.—As has already been stated, the immediate successor of the old flint-lock was the percussion or cap lock. While now far beyond its zenith, it is still the prevailing gun in many portions of the country; especially in out-of-the-way districts South and West. In the oldest make of these guns a small plug of iron is screwed into the barrel at the point where the touch-hole of the flint-lock was located. It is called the cylinder. The end passing into the barrel is drilled to communicate with the powder-bed of the gun, and with a cap-tube, which is screwed into the cylinder, to stand erect near the side of the barrel. In more modern guns the cylinder has been discarded, the tube going directly into the barrel and communicating with the powder-bed.

The oldest percussion-lock rifles are set in whole stock, on the plan of the flint-lock gun, and on account of the fact that all the old fashioned folks are not yet dead, some factories put up new guns after the same model, calling them Kentucky rifles. The stock reaches the full length of the barrel, which is heavy and about four feet long. It is octagon in shape. But in most of the more modern rifles the barrel is shorter, say from 32 to 36 inches in length, and comparatively light; and the stock extends only half the length of the barrel, joining to a rib affixed to the barrel for the purpose of holding the ramrod-thimbles.

The "patent-breech" may be mentioned as another peculiarity of the percussion-lock gun, since it was not known in the days ere the flint-lock had lost its prestige. In those early days the breech end of the barrel was closed by a plug of iron, screwed in and called the breech-pin. From its upper side there extended backward along the stock a thin plate or strap, through which screws passed at right angles to hold the barrel in place. This method of securing the breech-end of the barrel into the stock has been done away with by the patent breech, which secures it by means of a short hook on the end of the breech-pin; or, rather, on the end of the short plug screwed into the barrel in place of the old breech-pin. It is much more convenient than the old fashioned arrangement, as it enables the barrel to be taken from the stock in a moment, doing away with the labor of drawing the breech-pin screws.

On the Muzzle-Loaders. — The percussion-lock muzzle-loaders all work upon about the same principle. The charge must go in at the muzzle and be put down to the breech. In the case of army guns it is usually contained in a paper cartridge. The soldier bites off the end of the cartridge in which the powder is inclosed, to admit of a communication with the cap, and then forces it down with the ramrod. But in the case of rifles and fowling pieces, or shotguns, as the latter are most commonly called in this country, cartridges are seldom employed. In loading a rifle the powder is first measured in a "charger," and then poured down the barrel; next comes the patch, which is usually a piece of new and strong cotton cloth, most commonly the kind known as white drilling. This, having been tallowed upon one side, the tallowed side is spread over the muzzle of the gun, and the bullet is pressed upon it into the muzzle, the side from which the "neck," formed in moulding, has been cut, must be directly downward. Generally with the handle of a knife the bullet is pressed into the bore as far as it can be sent by such means; then the patch is gathered around it and cut smoothly off exactly flush with the muzzle end of the barrel. The next operation is to draw the ramrod, throw the gun under the left arm, with its breech resting upon the ground and its muzzle in front of the breast, and then having

set the butt end of the ramrod upon the bullet and grasped it in both hands, the bullet is gradually, and by main strength, forced downward into position. To make sure that it is entirely down the gun is taken from under the arm, by some, and set with the breech resting upon the ground more in front, after which the ramrod is raised up a foot or so and pitched down the bore like throwing a pike. If it does not bound back the bullet is not down solid upon the powder, and the pitching is repeated until it does bound. The upward bound of a few inches is sufficient to settle it that the bullet is down.

In the early times the bullet of the rifle was patched with dressed deer-skin exclusively.

Charging the shot-gun muzzle-loader is an operation somewhat different. First comes the powder poured down the bore from a charger, as in the case of the rifle. Next comes a wad, usually of paper, which must fit tightly, and be rammed down solid upon the powder. Following this comes the shot, measured in the same charger, or in one of the same capacity. The measure of powder and the measure of shot usually made about the same. Over the shot is rammed a loose wad—it needs only to be tight enough to prevent the shot from rolling out when the muzzle of the gun happens to come lower than the breech. Disk-like wads of pasteboard or felt cloth are the latest invention.

The Breech Loaders.—The breech-loading gun is now before the public in considerable variety; and being really the gun of the day, and, consequently, engaging the best thought of inventors, it is constantly appearing in new forms. This being the case, about all that could be expected in this work, is a mere mention of the general principles upon which it works.

Taking a double-barrel shot-gun for illustrating these general principles, it may be stated that the barrels are movable at the breech or rear end, and butt upon the face of the standing breech peculiar to the latest and best muzzle-loaders. The face of these barrels fits smoothly against that of the standing breech. There is nothing in the way of a breech-pin to resist the backward force of the ignited powder, or hold the barrels in place. The hooks mentioned as peculiar to the patent breech muzzle-loader are not there—nothing at all like them. But the barrels, when put into place for shooting are held there by means of a solid piece of iron attached to them underneath, called the "lump." To effect this, it descends into an iron bed on the stock called the "action," its projections fitting into suitable recesses in the action and being held there by the agency of keys, wedges, bolts or grips.

There are many devices for gripping, bolting or wedging up the gun, as it is called; and also many for attaching the barrels to the stock. In all cases the barrels play upon a hinge pin, which admits of their dropping down at the muzzle and rising at the breech, the latter to reject the empty cartridge and receive the loaded one. At every discharge the gun is opened and closed by throwing up the barrels for the purpose just named, and then letting them down again into position for shooting. The means by which this opening and closing is effected vary greatly in the guns of different makers.

Variety of Breech-Loaders.—This gives the general idea of about all there is of it. There are a few breech-loaders made in both this country and in Europe whose barrels are fixed, the cartridge being inserted through some other device; and there are still a few others whose barrels slide forward or sideways in the stock to receive the load—do not tilt on a hinge-pin—but neither of these kinds are so common as the kinds just referred to.

CHAPTER IV

Pistols Now in Use..... .. ..
Old Style Pistols.. . .. .
The Derringer. ....
The Pepper Box..... ... ...
Old Colt's Revolver. ....
Sharp's Four-shooter .. ..
The Breech Loading Cartridge Pistols..... .. ..

CHAPTER IV.

PISTOLS NOW IN USE.

Old-Style Pistols.—Pistols, the smallest of fire-arms, were originally plain implements of a single barrel; but, as improvements advanced, a second barrel was added to many of them, presenting what is known as the double-barreled pistol. Some of these old-fashioned single and double barreled pistols will still occasionally find their way into the shop of the gunsmith, though their numbers, as now in use, are comparatively small, especially the muzzle-loaders. In rare instances a flint-lock "horse pistol" or holster may put in an appearance, though none such are now on sale at any house dealing in fire-arms. Some few houses are still offering the old cap-lock army holster, always a second-hand article that once belonged to the Government, and was bought up by dealers when the Government had discarded it for the adoption of more modern and better arms. A description of this kind of weapon is unnecessary as it is simply a small musket with side-lock, and all on the usual plan, differing only in being short and having a turned-down handle, to be held in one hand, instead of the usual breech. The single or double-barrel muzzle-loaders, outside the line of army holsters, will usually have the central lock, which is next to no lock at all; simply a main-spring working in the handle and throwing the cap-hammer, which is fitted in the middle of the piece immediately behind the breech end of the barrel. Some very cheap pistols for boys are still made on this plan.

The Derringer.—The old Derringer, though not now much manufactured in this country, is still among the people in considerable numbers. It is a muzzle loader, with side-lock and full-stock in wood; and, by the way, it is a very good pistol of its kind.

The Pepper Box.—There are quite a number of little breech loading cartridge-pistols, with single barrels, now in use, but the pistol of the day is a repeater, of which there are kinds in great variety. One of the oldest and now rarest of these is the "pepper-box," so called. It has a single barrel con-

taining from five to seven bores, which are loaded from the muzzle. A tube for percussion caps communicates with each bore at the breech, and upon these a hammer strikes, having an automatic action, rising up and striking in response to pressure upon a trigger underneath, which pressure also revolves the barrel, bringing the caps into proper position for receiving the blow It was never a popular pistol, people objecting to a kind of way it had of sometimes letting off its seven charges simultaneously, when the person operating it had intended to fire but one.

Old Colt's Revolver.—Next among the repeaters, in point of scarcity, is the Colt's revolver of the earliest patent. It has a stationary single barrel and revolving cylinder, the latter containing from five to seven chambers for receiving the charges. It is not a muzzle loader, though the charges must be put into the chambers at the breech, somewhat on the muzzle-loading plan. It is fired by means of percussion caps. The cylinder revolves, throwing the chamber to be discharged into proper position at the breech of the barrel when the cap-hammer is drawn back. Though inconvenient, compared to the cartridge pistol of more modern make, the old Colt's revolver is yet an excellent arm. There are houses still making revolvers on the same plan.

Sharp's Four Shooter—Next to the old Colt's revolver may be placed the Sharp's four shooter. It is a neat and strong-shooting, little breech-loading pistol, using a No. 22 cartridge. The barrel has four bores but does not revolve: but the hammer has a revolving point, for striking the cartridge, which moves into proper position for a new discharge every time it is drawn back to full cock The barrel slides forward upon the stock for receiving new cartridges.

The Breech loading Cartridge Revolvers.—Next comes the regular breech-loading cartridge revolver, which is the pistol now most common and most popular. To attempt a detailed description of every style of this weapon would be to swell our book to unwieldy proportions, and even were the multitudinous styles at present before the public described, it would be impossible to keep pace with the number which would be constantly introduced. But, even were it possible to do so, no good purpose would be subserved. Various as the styles appear, they all embrace devices and combinations which are substantially covered by our several chapters, and the intelligent workman will not require minute descriptions to recognize or understand the individual weapon when well grounded in a knowledge of the class of fire-arms to which it belongs. It is our purpose to give such descriptions, directions and illustrations as shall make everything sufficiently clear and explicit to enable the reader, with careful attention thereto, to handle successfully and satisfactorily any job likely to come to his hands.

CHAPTER V.

On General Gunsmithing. ....
The Gunsmith and his Trade ....
Fitting up a Shop..... ....

CHAPTER V

ON GENERAL GUNSMITHING.

The Gunsmith and his Trade. Few trades present so little regular routine as does that of the gunsmith. In most trades it is the same thing over and over again; but, with the exception of taking the gun to pieces and putting it together; and, perhaps, of tempering, case hardening and the like, the gunsmith may work regularly for a long time without being called upon to do precisely the same thing twice. As a consequence, the gunsmith must be merely an ingenious mechanic or worker in metals, capable of thinking deeply and searching out causes and requirements—there is little need of his being anything more. The gun, in all its forms, is only a machine, and a simple one at that—so simple as to be easily understood by any one capacitated for making an intelligent study of machinery

Fitting up a Shop.—The specialties to claim the attention of the gunsmith in fitting up his shop if his means are limited may be few. It will be about like fitting up the shop of any general worker in metals. He will need a forge, an anvil and a vise; in a word he will need a light but complete set of blacksmith's tools, to begin with. This outfit will be his foundation, so to speak; and he can add to it such smaller tools as judgment and experience may suggest as wanted, such, for instance, as a hand-vise or two, cutting-pliers, bending pliers, holding pliers, small files of various shapes, small drills, a screw-plate or two, a few gravers, and so on. He might have many special tools, such as could not be bought at the ordinary hardware store, or at any house dealing in outfits for the general worker in metals, but for ordinary repairing, he will not have much need of them. Among the special tools that he will be compelled to have will be a rifle-guide, a few sets of rifle-saws and a few mould cherries. These with proper instructions he can make himself if he finds he cannot buy them cheaper than he can make them. There are a few specialties in the way of tools or machines for gunsmiths that are offered to the trade by houses dealing in gunsmith's materials, and some of them may be found very useful as labor-savers, but the gunsmith can get along without them if he does not wish to buy. Prominent among these is a mainspring vise or clamp, which has several advantages over the common hand-vise sometimes employed for clamping the mainspring. It would be well to look after these things, and to adopt them in every case where it appeared beyond question that they could be made to pay There is no occasion to speak against any of the specialties that may be presented to the attention of the trade—of their merits the party most concerned must be his own judge.

CHAPTER VI.

Taking Apart Cleaning and Putting Guns Together. .
To Take the Gun Apart. . . . . .
To Clean the Gun When Apart . . . .
To Put the Gun Together.... . . ..

CHAPTER VI.

TAKING APART, CLEANING AND PUTTING GUNS TOGETHER.

To Take the Gun Apart.—With the muzzle-loading guns now in common use this is an operation so simple as to be scarcely worthy a mention. If the gun is an old-fashioned breech-pinned muzzle-loader, the first thing is to push out the small wire pins or bolts which pass through the stock, under the barrel, and through the barrel-loops. The next thing is to draw the breechpin screw; this lets the barrel out of the stock. If it is desirable to unbreech the gun, it is done by clamping the breechpin in a vise, and then turning the barrel by hand until it is screwed off the pin

The patent-breech muzzle-loader comes apart the same way in every particular, with the exception that there is no breechpin screw to draw; the barrel can be easily lifted from the stock by simply raising the muzzle and unhooking the patent breech, so soon as the pins or bolts before mentioned as holding it down have been removed. The unbreeching is done at the vise much the same as in the other case.

To take apart the ordinary breech-loader, begin by setting the hammer at half-cock. Open the lever, then draw the bolt, starting it with a tap from the handle of the screwdriver. Next detach the forepiece, and the barrel will come out without further resistance. Instructions to take down and assemble different kinds of breech-loading guns will be found in Chapter XL.

To Clean the Gun when Apart.—In olden times a bucket of water and a wisp of tow and a stout "wiper" had to be brought into requisition, particularly for the interior of the barrel, but now these things are mainly obsolete, so far as relates to the outfit of the gunsmith. The owner of a muzzle loader, who does not wish to remove the breechpin, may still resort to the old plan of washing out the barrel, though there is now really no necessity for it. A little benzine poured down the muzzle, after stopping the tube, will do the work of cleaning effectually and in a few minutes. Let stand a short time, then remove the plug from the tube and force the benzine out by running down a tow wad on the wiper—all the dirt will go out through the tube with it, leaving you nothing to do but wipe the benzine from the bore with the tow.

In the case of a gun unbreeched, or a breech-loader, all that is necessary is to saturate a bit of cotton flannel with benzine and run it through the barrel a few times. If the gun is a fine one, well finished, this process will leave the interior as shining and bright as a mirror.

With the same arrangement rub thoroughly any of the metal parts that happen not to be clean, and all impurities will promptly leave them. After this, oil and wipe with a chamois skin, and the work is done.

Benzine may be had at any drug store at about the price of kerosene. It is especially valuable as a gun cleaner for two reasons: its peculiar fitness for detaching and carrying away dirt, and its highly volatile properties, which cause it to evaporate and entirely leave the metal in a short time after the application has been made. Its adoption has completely done away with the necessity of ever using a drop of water upon a gun, in any case, which is a matter of decided importance and advantage.

To Put the Gun Together.—With the muzzle-loaders the operation of putting together is simply a work directly in reverse to that of taking apart. In case of the common make of breech-loaders a little more variation may be regarded as necessary. Take the grip of the stock in the left hand, having the lever open. Hook on the barrel and turn the gun over with the hammers underneath, still holding the stock at the grip. The weight of the barrel will keep it in place. With the right hand attach the forepiece and push in the bolt.

Of course there are guns of peculiar make, now and then to be met with, which will require a different routine, both in taking apart and putting together. The details, with full directions for taking down and assembling nearly all the breech-loading guns now made, will be found explained, with cuts of their mechanism and working parts, in Chapter XLII.

A careful study will soon show the gunsmith how they come apart and how they go together. The main thing is to work with extreme care, and to never act until you clearly understand what you are doing.

CHAPTER VII.

TOOLS REQUIRED FOR WORK, THEIR COST, ETC.
The Alcohol Lamp
The Alcohol Lamp, Self-blowing
Anvil
Barrel Planer
Bevel
Beveling Clamp
Blacksmith's Tongs
Blow Pipe
Breeching Tape
Calipers and Dividers
Chisels
Cutting Pliers
Drill Stock
Tile Cord
Tilting Square
Floats
Forge
Glue Pot
Gouges
Grind Stone
Hack Saw
Hammers
Handles
Hand Shears
Hand Vise
Iron Clamps
Mainspring Vise
Marking Gauge
Screw-cutting Tools
Screw Wrench
Soldering Copper
Screw Drivers
Pliers
Wing Dividers

CHAPTER VII.

TOOLS REQUIRED FOR WORK, THEIR COST, ETC.

Given in alphabetical order are some of the tools that will be required by the gunsmith, and in connection a very brief sketch is given of their approxi-

mate cost at hardware stores. This list is intended only as a sort of guide in purchasing, and is by no means intended as a complete list of what may be [illegible]

The Alcohol Lamp.—This lamp, shown in Fig. 1, is useful for small soldering, tempering small taps,

FIGURE 1.

drills, etc. Glass or brass lamps with caps to prevent evaporation, are sold for about 50 cents each.

Alcohol Lamp, Self-Blowing.—This lamp, shown in Fig. 2, very convenient when continued blowing is required, or when the "knack" of using the common plow-pipe cannot be readily acquired. It may be used for soldering, brazing small articles, or hardening small tools. Size 2½ inches diameter and 5 inches high, $2; about 3 inches diameter and 6 inches high, $3.

Anvil.—An anvil weighing about ninety or one hundred pounds is heavy enough. An Eagle anvil of this weight will cost about $9 or $10. The body of this kind of anvil is cast iron with steel face and horn. Price per pound is about ten cents.

Barrel Planes.—These planes are now but little used, except for stocking guns or rifles which are to

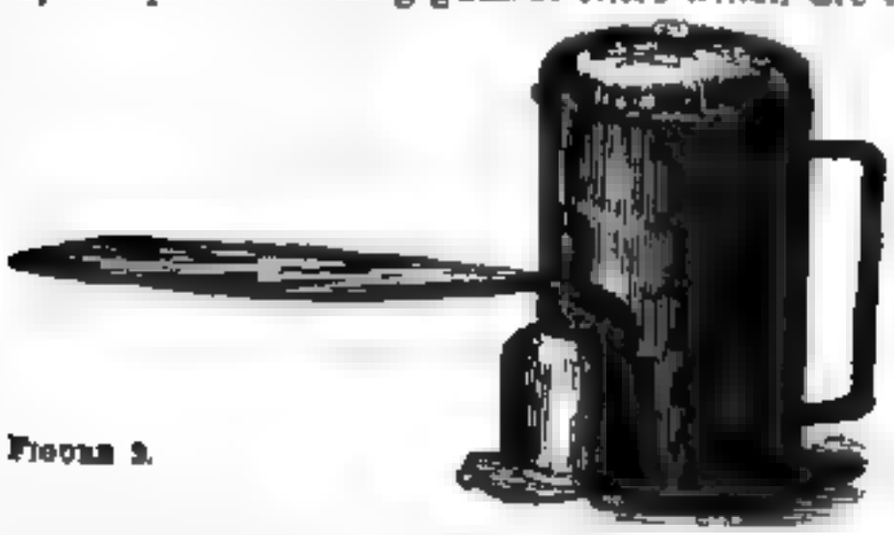

FIGURE 2.

be fitted with full-length stocks. As this form of gun is somewhat going out of use, so the stocker's planes are getting to be cast to one side. They are made similar to a narrow rabbet plane, but have the iron set close to the fore end. Any narrow plane with the fore end cut off to within half an inch of the opening in which the iron is placed will make a substitute for the stocker's plane. The plane with round face is used to let in round barrels, and one with a face equal in width to the sides of an octagon barrel, for letting in such barrels. A narrow plane is used to let in the ramrod, by cutting a groove centrally in the bottom of the barrel groove. The planes used are about four in number and the cost is about seven or eight dollars for the set as sold by dealers.

Bevel.—Bevels for ascertaining and forming surfaces, not at a right angle with some certain line, can be had from one dollar upward in price. The four inch is very good size. The blade is held in position by a screw, which forms part of the joint on which the blade turns. Shown in Fig. 3.

FIGURE 3.

Beveling Clamp.—These tools are generally made of about three sizes, and are used for holding hammers when filing the bevel upon the sides. They are also useful for holding lock-plates while filing the bevel on them. In the vise, work can only be conveniently held at a vertical or horizontal position; this clamp is designed to furnish a means to hold it so as to file an angle of about 45 degrees. The tool is shown in Fig. 4. It is held in the vise, the shoulders resting on the vise jaws. The spring between the jointed portions opens the tool when the vice jaws are opened, the closing of the vise jaws, of course, closing the clamp upon the work that is placed in it. The cost of these tools is from two to three dollars, according to size and quality.

FIGURE 4.

Blacksmith Tongs.—Blacksmith tongs can now be purchased of the hardware dealer. The twelve inch length are used for small work, and the fifteen or eighteen for heavier work. The twelve inch cost about 50 cents; the fifteen, 62, and the eighteen, 75 cents each.

Blow-Pipe.—Select a blow-pipe eight or ten inches in length, with bulb or without, as fancy may dictate. If the end where the mouth comes in contact be silver or nickle-plated, it will not taste of brass. If it be difficult to get one plated, tin it with soft solder by wetting with soldering acid, and melting the solder on it by holding it over the lamp. Wipe off all superfluous solder with a rag. The cost of plain eight or ten inch pipe is about 25 cents. Add about one-third or one-half this price for pipes with bulb.

Breeching Taps.—Breeching taps ought to be obtained in pairs, one to enter first and another to follow, cutting a full thread at the bottom. The prices per pair are for the ⅜ inch $2.25, ½ inch, $2.50, ⅝ inch, $3.75. For shot gun taps, ½ inch, $3.00, ½ inch, $3.25. A stock with dies will cost about a like sum, but if the stock be fitted with only two sets of dies, it will be much less. The two threads used for rifle pins are 14 and 16 to the inch.

The 14 and 16 threads are not always adhered to. A house in Philadelphia say they use taps of 18 threads, and a firm in Pittsburg advertise taps of 20 threads per inch.

Calipers and Dividers. The best length of spring

calipers and dividers, for common bench work, is about four inches. The cost is from 50 cents to $1.50, according to quality.

Chisels.—The chisels, as used by stockers, are about half a dozen in number. The narrowest is about one-eighth of an inch wide, and the widest about half inch. The set of six will cost about a dollar or a dollar and a half.

Cutting Pliers.—A pair of cutting pliers, six inches in length, for cutting wire, are indispensable. Select those of good quality. Poor pliers of this description are poor, indeed. The cost will be from 75 cents to $1.50. There are patented pliers of this kind in market that are recommended by many who use them.

Drill Stock.—Many kinds are in market, from eight inches in length upward. Some are termed hand drills, and the larger ones, used against the breast, are called breast drills. The hand drills can be obtained as low as 50 cents and upward; the price of breast drills from two to three dollars. Select a drill stock, if one be required, of a size and strength to suit the work to which it will be used.

File Card.—This is for cleaning filings, dirt, etc., that may collect in files. It consists of a strip of common cotton card tacked to a piece of wood.con-

FIGURE 5

veniently shaped to handle. It is also useful to clean the dirt and debris that will collect in screw taps. The cost is about 25 cents. Shown in Fig. 5.

Fitting Square.—A fitting square with a four, five or six-inch blade is required for many purposes, not only for laying out iron stocks and marking off "square work," but other work that will come into a gun shop. The gun squares used by carpenters and cabinet makers are very good. If the stock be of iron, or an iron frame filled with wood, they are better than those with wooden stocks. The cost of the six-inch may be about 75 cents. The other somewhat less.

Floats.—For half-stocking, the gouge and floats are used for letting in barrels. The floats are made with a handle bent at an angle so that the hand will not hit the work. The round float in form resembles a gouge with teeth like a coarse file cut on the rounded or bottom surface. Floats have been made by drawing the temper of a thick gouge and cutting teeth in it, or taking a half-round file and drawing the temper, and then cutting teeth on the round side. Floats for octagon barrels are flat, like a chisel with teeth cut on one of the flat sides. A thin float for letting in cross bolts is made in the same manner. A float for fitting ramrods may be made of a steel rod with teeth cut on one end, and a handle fixed to the other. The bolt float will cost about 50 cents. The rod float about $1.00 each for two sizes. Rifle, two sizes, about $1.25 each. Shot gun, two sizes, about $1.50 each.

Forge. Little advice can be given respecting a forge. Some prefer the bellows forge, while others select the fan blower. The great requirement of the gunsmith is portability and occupying little space. It should also be so enclosed as to prevent escape of dust, and be free from accident of fire escaping if left with the fire lighted. The cost of either form of portable forge will be from $20. upward.

Glue Pot.—Glue pots can be purchased with kettle fitting inside the pot and tinned on inside, quart size about 75 cents. A glue pot may be extemporized by selecting a common round fruit can, cutting out the cover so as to allow a smaller can to fit and be held in place. Where economy is desired or a pot cannot be purchased, the can glue pot will answer every purpose.

Gouges.—About six gouges are needed. The sizes are about one-eighth for the smallest, and increasing to three-quarters for the largest. The cost of the set will be about one dollar and a quarter.

Grind Stone.—An Ohio stone, about 20 inches diameter and 2½ inches thick, mounted plain, can be got up for about three or four dollars. The iron fixtures will cost about a dollar, and the stone a cent and a half or more per pound, according to locality.

Hack Saw.—A hack saw shown in Fig. 6, with iron frame, to hold a blade of eight or ten inches in

FIGURE 6.

length is required for cutting off barrels, slotting screws, cutting off rods of iron, brass, etc., besides many other uses. The eight inch with blade will cost about $1.25, the ten inch about $1.50. If at any time a blade be broken they can be replaced at from 25 to 50 cents.

Hammers.—In choosing hammers select the plain riveting hammer with cross pein. The sizes generally most used are a four ounce, a twelve ounce and a heavier one for use at the forge. The four ounce costing about 30 cents, the twelve ounce about 50 cents, and the larger one according to weight. In selecting hammers try the pein with a fine file to learn the temper. In many cases the pein is left too soft for riveting steel.

Handles.—Handles for files or screwdrivers are best when made of maple or apple wood. Maple is generally preferred. Some mechanics like soft wood, as bass-wood or white birch, for file handles, but they are not so neat as those made of maple. Get those with ferrules made from sheet brass, raised to form. Soft wood handles are worth about 25 cents per dozen, and the hard wood about 50 cents.

Hand Shears.—For cutting sheet tin, brass, thin sheet steel, small springs, etc., select a pair of hand shears about nine or ten inches in length, costing about $1.50. With these, common watch-springs can be cut lengthwise, for making small springs for pistols. The temper need not be drawn to cut them.

FIGURE 7.

(Shown in Fig. 7.)

Hand-vise.—A hand-vise for holding wire, screws, etc., is needed. About four or four and a half inches in length is most convenient. For holding small wire, cut a groove with a three-square file across the jaws toward the jointed end. The cost will be from 50 cents to $1.00, according to quality.

Iron Clamps.—A pair of malleable iron clamps (shown in Fig. 8), opening about four inches, are

FIGURE 8.

useful for holding barrels into the stock during stocking, holding a lock plate or strap in place for marking, holding barrels together pieces of wood to be glued, etc. Cost, about 50 cents each.

Mainspring Vise.—This tool (shown in Fig. 9, as clamping a spring) is used to clamp the mainspring, preparatory to removing it from the lock. The hammer is set at full cock, and the vise applied, the screw tightened until the spring can be lifted from place. In taking down double guns, a vise for each lock spring is very convenient, as the springs can then rest in the vise, being crumped in place, until

FIGURE 9.

ready to be put back into their respective places. The cost of these vises is from 25 cents to $2 each, according to quality and make. For a left-side lock, reverse the sliding piece, so that the short end will bear on the bend of the mainspring.

Marking Gauge.—A wood marking gauge is used for laying out lines parallel to a surface already formed. If made of beech wood, and plain, it is generally sold for about 25 cents each.

Screw-cutting Tools.—A small die stock and dies, with taps for lock work, will cost about $2.50. A plate and ten taps, suitable for all sizes of nipples, English and German, can be had for about $8.00.

Screw Wrench.—One of Coe's patent wrenches, about twelve inch size, costing about a dollar, is the best make and the most durable size for all purposes. This wrench is generally known as a "monkey wrench."

Soldering Copper.—A copper for soldering, similar to the kind used by tinners, is the kind to get. A good size—No. 3—will weigh about a pound and a half, costing about 75 cents.

Screw drivers.—Several screw-drivers are required, and of several widths, to fit different sized screw heads. The narrowest may be about one eighth inch, and the widest, say, half inch to five-eighths inch. If the mechanic desires to make these himself, select octagon steel, about one-quarter inch diameter, draw one end to form the tang, and the other to form the screw-driving part. Get good apple, beech or maple wood handles. Let the length project about six or seven inches from the handle. For the larger size screw-drivers get steel three-eighths diameter. Old files, with the temper drawn and the points ground to shape, make a passable screw-driver. Screw-drivers purchased at the store, are generally not so satisfactory as those made from rods. Stub's round steel wire rod makes good screwdrivers.

Pliers—Three kinds of pliers are used by gunsmiths; flat nose, round nose, and long flat nose or clock-makers' pliers. Six inch is about the right length for general use. The round nose are useful for bending wire or metal into circular forms. The long flat nose for holding work for soldering and handling work at the forge. Of the flat nose a five inch pair are useful in many cases. The cost of pliers (six inch), is from about 50 cents to $1.00 per pair according to quality.

Wing Dividers—A pair of wing dividers, about eight inches in length, will be found the best size for general use. The cost will be about 75 cents. In purchasing see that the screw that binds the leg to the arc or wing is well fitted. The thread either in the leg or the screw, is sometimes stripped or worn out after a little using.

CHAPTER VIII.

Tools, etc., and How to Make Them.....
The Alcohol Lamp .....
A Self-blowing Lamp .....
Breech Wrenches.....
The Bit Stock .....
Bottoming Tools .....
Chequering Tools.....
Nipple Wrenches.....
Portable Forge .....
Vise Appendages.....
Shanks of Tools.....

CHAPTER VIII.

TOOLS, ETC., AND HOW TO MAKE THEM.

THE tools given in this chapter are such as are needed by the gunsmith, and as directions are given for making them, they can be made by almost any ingenious person during leisure hours.

The Alcohol Lamp.—A lamp for this kind of work is easily made. A common gum or mucilage bottle with a tube inserted in the cork has been used, so has a small tin spice-box, with a tube soldered into

the cover. A common copper or brass cartridge, with the head filed off, can be used for a tube. A common oil can, such as is used for oiling sewing machines, with about half of the taper tube cut off, will make a serviceable lamp. These appliances are small, unsightly and not to the taste of the mechanic who has a pride in the appearance of his tools.

The best form of lamp, shown in Fig. 10, may be made by obtaining a small glass kerosene hand lamp, which will cost only a trifle of two or three shillings. Cut off that portion of the burner above the screw, where it is held to the socket that is fastened to the lamp. Remove the tube that holds the lamp-wick and also the little contrivance made to raise and lower the wick. In the place where the tube was inserted, generally a flat one, file out with a round file, a place which is large enough to receive a common brass 44-cartridge that has had the head cut off or removed by filing; this is the tube for the wick. Fasten it in place with soft solder. Let this tube project a little into the lamp, and solder it on the under side. The greater portion of the tube projects above the place where soldered.

FIGURE 10.

The wick is made of common cotton wicking, letting the end inside touch the bottom of the lamp. Fill with alcohol, and the lamp is ready for use. Be careful that the wick is not too tight in the tube, or in other words, do not fill the tube with too much wick, as it will prevent the alcohol from rising and the lamp from burning. To prevent evaporation of the alcohol and to have the wick always ready for lighting, cover the tube with a cap that fits it quite closely and has the upper end closed. A brass cartridge that will go over the tube makes a good cover. Remove the primed cap or see that the cap has been exploded before using it to cover the lamp tube.

A Self-blowing Lamp.—A very good form of this lamp is shown in Fig. 11. It consists of a lamp enclosed in a kind of cup which has an open place at the bottom to admit the lamp and a small boiler, fitting loosely, and held by a flange on its top. A small pipe is soldered to the top of this boiler and extends downward, and has an end like a blow-pipe that passes through one side of the cup and ends near or a little above the lamp wick. The operation is as follows: the lamp being lighted, heats alcohol

FIGURE 11.

placed in the boiler, and the steam thereby made produces a jet that blows the lamp flame the same as is done with the mouth.

The size of the cup may be from three inches to three and a half in diameter, and about five inches high. The opening at the bottom may extend about half of the height. The lamp is made of less diameter than the interior of the cup to admit of moving to get a good flame from the blow-pipe. The lamp may be 1¼ inches in diameter and an inch high. The boiler is about two inches high and has the bottom made a little convex, as shown by dotted lines, and is some smaller than at the top where a flange is formed to admit of its resting on the top of the cup. The top of the boiler is also convex, and has a short tube in which a cork is fitted, for the purpose of filling it. The blowing tube is about three-sixteenths of an inch in diameter. There is a long slot in the cup near its handle which readily admits of its being put in position for blowing. There are several small holes near the top of the cup to insure draft to the lamp, and there is a large hole about an inch in diameter opposite the end of the blow-pipe through which the flame issues where the work is held.

For silver soldering, small brazing, tempering, or any similar small work, this lamp is most excellent. To make the small blowing-pipe, drill a smooth hole through a piece of iron or steel and ream out one side of it. Cut a strip of thin copper or soft brass of a width just enough to fill the hole if it were made into a tube. Point one end of the strip and roughly form it into a tube, insert in the hole and pull it through. Or the strip can be rolled around a piece of iron wire forming it to a tube by hammering. Soft solder it after being formed to shape.

Breech Wrenches.—In many shops the monkey wrench is made to do duty in removing breech-pins,

FIGURE 12.

but at the expense of marring the pin where the wrench engages it. If many guns with breech-pins like those used in army guns are handled, it is worth while to have solid wrenches forged of iron like Fig. 12. The length may be about fifteen inches, with

an opening to fit the shoulder of the breech-pin. The width at this place may be about one and a half inches, thickness, about half an inch; diameter at end of handle, about three-quarters of an inch, and at the small portions near the centre, about half an inch.

A wrench for removing patent breeches or nuts from double guns is made like Fig. 13. It consists of a steel bar about fifteen or sixteen inches long and about three-quarters of an inch diameter. At a little to one side of the center is fastened a steel collar that has four projections made at one end. A similar piece is fitted opposite to it, but is made to move back and forth to fit the work by means of a screw that is formed behind where it is fitted. A slot is made in the extension of the piece and a key fitted to prevent its turning around as the nut is turned to advance it toward its fellow piece.

The only substitute to answer for this tool is to file down the jaws of a monkey wrench so that they will turn between the extensions of a patent breech while the first breech is being removed. This is a poor substitute, as there is only one handle to turn with, and when force is applied to remove the breech

FIGURE 13.

it does not have the force applied equally to each side as in the other kind of wrench, consequently it is not as effective nor so easy to remove the breech. If an extension to form another handle could be improvised it would make it much better

The Bit Stock Even if the gunsmith have a lathe there is much work that can be done to advantage with a common bit-stock. But as the drills and tools used in the lathe generally have round shanks by which to hold them in the chuck, the square hole where bits and tools are held in the bit-stock must be filled by brazing or soldering a piece of iron into it and boring a hole to fit the shank of the lathe tools. It is advisable to have these shanks about seven-sixteenths diameter, as explained under the heading "Shanks of Tools."

In holding small drills made of steel wire or twist drills a small drill chuck must be fitted to the bit [redacted]

A small solid chuck with a quarter inch hole may be made with a shank to fit the seven-sixteenth hole. A set screw must be fitted to hold the shanks of the two sizes mentioned

Bottoming Tools.—Bottoming tools are used for letting in locks, cutting out for escutcheons, and are useful in other places where a chisel cannot be made

FIGURE 14.

to operate. The form of this tool is shown in Fig. 14. It consists of a square or round shank about three-sixteenths or a quarter inch in diameter and about six inches long. At one end a wooden handle is attached, and the other end is bent at an angle which is about half an inch or perhaps a little more, and on this angle is another one turned parallel with the shank and which is about three-eighths of an inch long. This is the cutting end and is fashioned like the cutting edge of a chisel, and is about a quarter of an inch wide. The bottom side, as it would be held for use, is ground flat and the upper side bevelled like a chisel. The cutting edge may be square or rounded to suit round places as letting in the bridle of a lock. The size given is that generally used, but if it be made about twice this size it will be found very useful in letting in octogon rifle barrels; if the tool be made larger and hollow like a gouge it is very useful in letting in round gun barrels. In letting in break off straps it will be found to take the place of a chisel to some advantage.

Chequering Tools—The tools used for chequering are very simple. Imagine a small saw, or rather

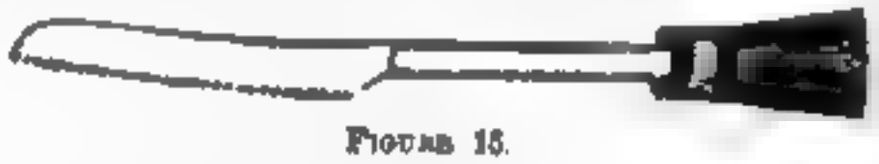

FIGURE 15.

two small saws about one inch or more long, made at the end of a straight steel shank. The form is given in Fig. 15. The double saw can be made by filing it as one thick saw and then cutting a groove lengthwise with it. In using, one blade first forms a groove and the other blade works the next cut, as the first cut is finished, another mark is being made while so doing. This insures equal width of the cuts. Care must be exercised in using them so as not to tear the wood. A fine cut, sharp edged, three square or a small half round file may be used to finish the work if desired

Nipple Wrenches.—Two forms of nipple wrenches are used, one for square and the other for two sided nipples. The most serviceable of these are made from a straight rod of steel, with a cross handle and an opening at the opposite end to correspond with the square on the nipple. For the two-sided, a hole to receive the round part of the nipple where the cap goes on, may be drilled in a rod of steel and a slot filed across to receive the shoulders of the sides. The square shouldered kind must have a hole drilled of the diameter of the square, and then being heated a square punch of the size of the square is driven in. The nipples used for Government or military arms have the squares larger than sporting guns, and the wrenches are generally made of a flat piece of steel with a square hole made through from side to side at one end and squared to fit the tube. When made, harden and draw to a blue color for temper

Portable Forge. The following description of a "home made" portable forge shown in Fig. 16 is given by a contributor to the *Blacksmith and Wheelwright*: "In size it is two feet square and three feet high; it is made entirely of wood; the

bellows are round and are sixteen and a half inches in size, covered then with the best sheep skins. The bed of the forge consists of a box six inches deep. It is supported by corner posts, all as shown in the sketch. Through the centre of the bottom is a hole six inches in diameter for the tuyere; this is three inches in outside diameter, and is six inches high. The bed is lined with brick and clay. It does not heat through. The bellows are blown up by means of two half circles with straps from a board running across the bottom, all of which will be better under-

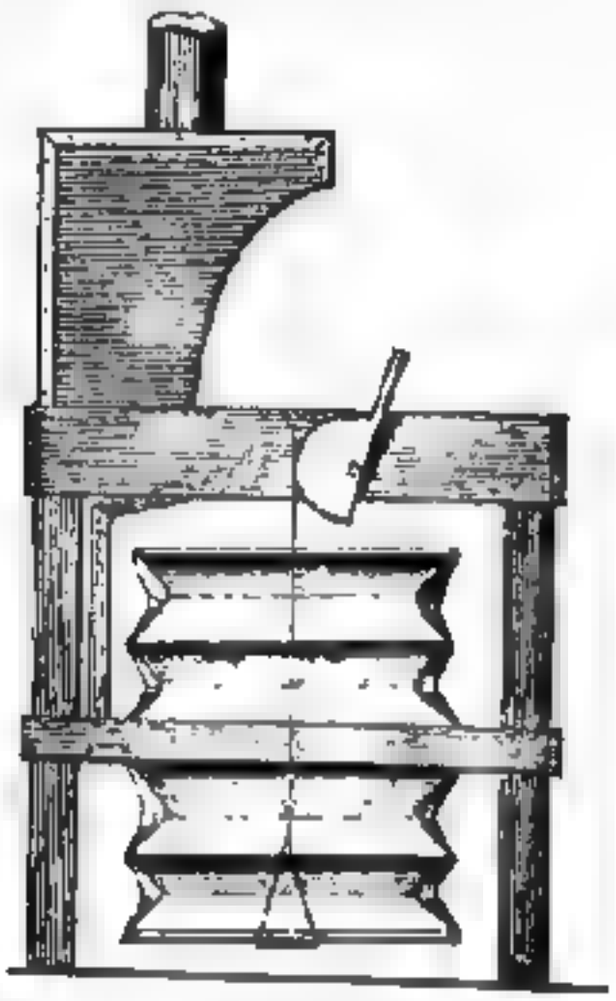

FIGURE 14.

stood by reference to the sketch In addition to protecting the bed by brick and clay, the tuyere is set through a piece of sheet iron doubled and properly secured in place. The hood which surmounts the forge may be made out of old sheet iron, and will be found sufficient for the purpose. The connection between the tuyere and bellows is a tin pipe."

Vise Appendages.—The best vise for general use is one made by C. Parker, Meriden, Conn., and is termed a "swivel" vise. To the bench is attached a round plate of iron, and on this plate the vise turns to right or left as may be desired. It is held in position by screwing up a nut by means of a han-

FIGURE 17

dle underneath the bench. The jaws are of steel, and a small projection back of the jaws, formed like a small anvil, is very convenient for bending work or to lay work upon for cutting, working with prick punch, etc. The width of jaws of No. 22, the size that is most convenient, is three and five-eighths inches, the weight about thirty-five or forty pounds, and the price about eight dollars, or perhaps a little more. This vise is shown in Fig 17.

As the jaws of the vise where the steel faces come together are cut like a file and tempered, they will necessarily mar or bruise the work. Pieces of brass or copper must be bent so as to be retained in place and at the same time cover the file-like surface of the jaws. Pieces of leather, common belt leather, upon which a little beeswax has been spread, may be placed between the jaws, and by forcing them together with the screw the leather will be retained in place. In holding barrels, stocks, and for stocking a fixture made like the cut, Fig. 18, is best. Two

FIGURE 18.

pieces of thin board, or even two pieces of a wide barrel stave may make it. The opening is for the purpose of "straddling" the square box of the vise that encloses the screw. Nail a piece of wood about an inch and a half thick across the bottom part, before the opening is made, and also nail a thin piece across the top of the pieces, being careful to sink the nail heads to as to not mar the work. The top ends of the fixture must come even with the top of the vise jaws.

For holding screws without damaging the heads use a pair of false jaws made of cast brass, like those shown in Fig. 19. The heads being held in the indentations formed along the upper edges of the fixture. For holding rods or small square pieces with-

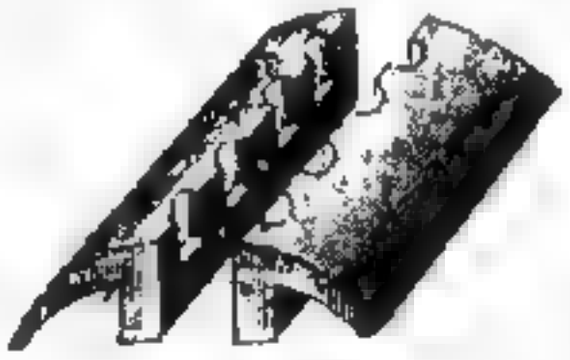

FIGURE 19.

out injury a similar pair of false jaws are made which are shown in Fig 20

For holding articles that are tapering a fixture is required like that given in Fig. 21. The yoke clasps

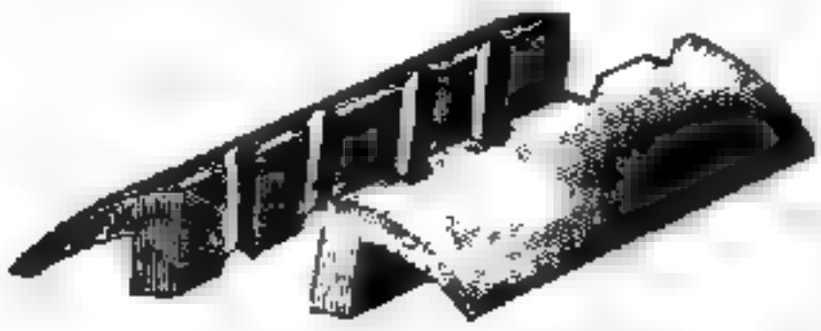

FIGURE 20.

the neck of the vise, and is held in place by a set-screw. The upright pin is received in the yoke by turning on a screw cut for the purpose, and by turning this up or down, the triangular piece at the upper part is made to accommodate itself to the height of the vise. The back angular corner of this piece has a bearing against the jaw of the vise, and the opening made between the other jaw of the vise and the front of this angular piece will be the same as the piece of work that is held between the two.

Shanks of Tools.—The best two sizes for shanks of tools are about seven-sixteenths and about quarter-inch. Two solid chucks, fitted with set-

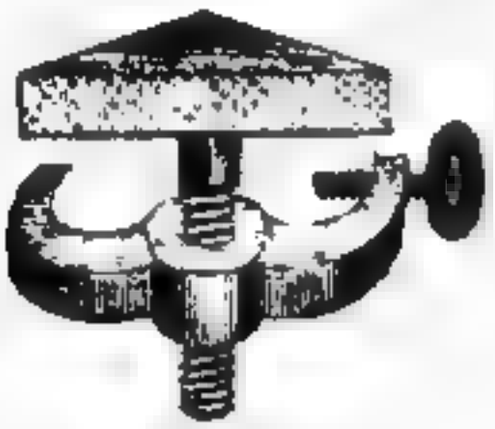

Fig. 21.

screws, may be made for the lathe, and they will be found sufficient for all kinds of work. If half-inch octagon steel be used for the larger size, a light chip turned off for about an inch and a quarter, or an inch and a half, will make the shank. From this size steel may be made large drills, reamers, countersinks, bullet cherries, etc. The shanks of many other tools may be made to this standard. When a bit stock is fitted to hold this size of shank, the tools may be used either in the lathe or by hand with the bit stock.

Octagon steel, a quarter-inch in diameter, may be used for smaller tools, or round steel rod of this size may be employed. For small drills and tools, taps, etc., it will be found very convenient. No turning is necessary to fit to the solid chuck.

The common cheap bit stock, made from round steel, may be selected, and the square hole filled with a piece of iron and then brazed to make it solid. A hole is then drilled to fit the seven-sixteenths shank.

A solid chuck is to be made to fit this, and drilled with a quarter-inch hole to fit the smaller sized shanks. This solid chuck will also fit the chuck for the lathe. If barrel boring tools, quick boring reamers, be made with the larger sized shank, they can be used both in the lathe and with the bit stock.

CHAPTER IX.

The Work Bench
Material for the Work Bench
How to Make the Work Bench
Putting the Vise in Place
Place for Drawer
The Gun Brace
How to Deaden the Noise of Hammering

CHAPTER IX.

THE WORK BENCH

Material for the Work Bench. The first thing to do in fitting up a shop is to put up a work bench. Do not make a rude affair of an unplaned plank and a rough board, but let it be seen that you fitted up your bench for use, and at the same time sought to have it neat and durable. A plank two inches thick is heavy enough; yet in some respects it is light enough; for the front portion of the bench twelve or fourteen inches is a good width. Pine wood makes a very good bench, but as it is soft, it will absorb oil, and in time will become black and dirty. As a remedy for this, give it two or three coats of shellac varnish. The best bench is made from a hard or sugar maple plank that has been well seasoned and has been planed true in a planing machine. Ash wood does very well, so does beech. Oak is not good; it absorbs grease and dirt readily, and if struck much with a hammer will soon show splinters, the fibres of the wood easily separating by the blows. A hard maple plank has one advantage; after being discarded as a bench, it will make good rifle stocks; the years of use will so season it that it will be valuable. For that part of the bench—that is, back of the two inch plank—use a board ten or twelve inches wide. Select pine or any other kind that fancy may dictate. Calculate the plank and board so that the width of the bench will be twenty-two or twenty-four inches.

How to Make the Work Bench.—For supports for the bench use 2x4 inch studding, such as carpenters use in house building. Pine, oak or any other material will answer. Plane smooth on all sides. For each support cut three pieces; two of the height of the bench, and one about an inch less than the width, so that when the bench is made the plank in front projects an inch or so in front of the supports. As the short piece on which the bench rests is four inches wide, cut away half of the thickness of the uprights of this width at the upper end, and cut enough in length to receive the short piece, when it is halved together—as is the term used—thus making it four inches thick when put in place. Fasten with nails or screws—the latter being the best fastening. To keep these uprights steady, nail a piece of board about three inches wide, and about twelve inches from the bottom, from front to the rear upright. On these pieces a board or two may be placed, with the other end resting upon a neighboring support, and it forms a convenient shelf upon which to place boxes and other things that will soon accumulate in any shop.

The height of bench from the floor may be about two feet and ten inches and a half. This will be found to be the most convenient height.

Putting the Vise in Place.—In putting the vise in place, fix it on the bench far enough in front so that if a gun stock or barrel were held upright in the jaws it will not touch the bench. If there be a window in front, put it a little to the left of the window. The light will then shine more on the right side of the vise, and consequently it will be more easy to distinguish lines or marks that may be made on work held in the jaws, as it is more convenient to look on the right side of work to see what is being done than on the left. The height of

the vise at the top of the jaws should be on a level with the elbow of the person who is to work at it. In no instance try to work with the jaws of the vise higher than the elbows as the workman stands erect before it. The reason is this: as the workman grasps the file handle in the right hand and the point of the file in the left, the arms are in a natural position, and can be thrust forward and brought back in a horizontal line. If the elbows were to be raised from the natural position the horizontal forward and back motion could not be made with facility.

Place for Drawer.—A few inches to the right of the vise is the best location for a drawer. This is generally opened or drawn out with the right hand, and when so placed can be readily opened with that hand without stepping to one side.

The Gun Brace.—A gun brace, as shown in Fig. 39, is made from a piece of inch and a half or two inch plank, with its upper edge of a height about an inch less than the height of the vise jaws. It is hinged or pivoted by a single screw passing through the end of the bottom extension, this screw passing into the bench, the brace turning freely upon it. It can be swung around back out of the way, and when needed for use is turned in front, and is ready to support a barrel or gun stock which is held in the vise. This brace is put to the right of the vise, but if another one like it is put in the left side it will be found useful at times.

In cutting out gun-stocks from the plank, many times pieces of just the right form for these braces

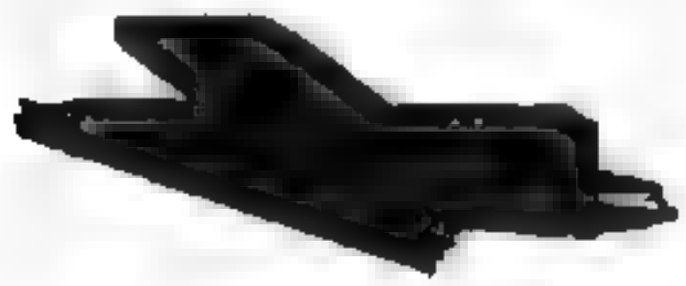

FIGURE 39.

will be found among the "scraps" that will be made. The shape is of little moment so long as they are of the proper height and have an extension through which to put the pivot screw.

To Deaden the Noise of Hammering.—In shops, especially if the work-room be in an upper story, to deaden the noise of hammering, etc., put pieces of rubber under the legs of work benches, the feet of lathes, anvil block, etc. If rubber cannot be obtained, any woolen texture as felt or thick loose-made cloth may answer the purpose, but not with so good results as the rubber. The anvil may be set in a tub made by cutting off the top of a barrel to the right height and filling it nearly full of sand or earth.

CHAPTER X.

On Working in Iron
Hand Forging.
Welding.
Hardening Iron by Hammering
Case-hardening
A Good Way to Case-harden.
Materials for Case-hardening
Another Way to Case-harden.
Another Formula for Case-hardening
Still Another Formula
To Chill Cast Iron.
Another Mode.
To Soften Wrought Iron.
Alloy for Filling Holes in Iron.
To Harden Iron for Polishing.

CHAPTER X.

ON WORKING IN IRON.

Hand-Forging.—Two rates of heat figure in this operation. If the object is merely a smoothing of the surface of the iron, the "cherry red heat," so-called, is the rate wanted. The work of smoothing is performed by striking lightly and evenly with the hand-hammer, until the desired condition is secured. The same degree of heat is employed where hammer-hardening the iron is one of the objects to be obtained; in this case the blows with the hammer must be heavier than in the case first named.

If the forging is to extend to a material change in the shape of the iron, the rate of heat must be much higher; it must be increased to what smiths call the "white flame heat." The hammering must be much heavier, of course; if the piece is large a sledge-hammer must be brought into requisition. But the gunsmith will seldom have work heavy enough to demand the aid of an assistant with a sledge-hammer.

Welding.—The "welding" or "sparkling heat" is required in this process, which is a higher degree of heat than either named in the forgoing. In securing this heat, the metal is brought nearly to a state of fusion; which condition is made known by its sparkling, and presenting the appearance of being covered with a glaze, or a fresh coat of varnish. So soon as the two pieces of iron to be welded together have both attained to this necessary degree of heat, they are taken from the fire with the utmost dispatch, the scales or dirt which would hinder their incorporation scraped off, placed in contact at the heated point, and hammered until a union has been effected, and no seam or fissure remains visible. If the first effort fails to unite them sufficiently, they must be reheated and rehammered until the desired end is secured.

The fire for welding should be free from sulphur; and the iron, while heating, should be taken out now and then and sprinkled over at the point of greatest heat with powdered glass, or with powdered borax. A small proportion of sand or powdered clay is sometimes mixed with the borax. These applications tend to prevent the iron from running or burning, and they are supposed to assist the adhesion when the two pieces are brought together in the act of welding.

Hardening Iron by Hammering.—Iron may be hardened to the character of a pretty fair spring metal by simply hammering it thoroughly while in a cold state. Many of the cheap spiral springs in use, as those attached to small bells for the purpose of imparting a vibratory motion, are hardened or stiffened in this way. They are first cut from soft sheet-iron and then hammered into the required hardness. Some heat to a cherry red and hammer to and after entire coldness.

Case-Hardening.—The various parts of gun mountings, such as guards, heel plates, etc., and the different parts of locks, such as hammers, tumblers, triggers and plates, as received by the gunsmith from the manufacturer or dealer in such articles, are generally in the rough or partially finished condition. Many gunsmiths, particularly those in the country, where there is more or less a class of cheap work, finish up these parts with a file and a little hand polishing, and when the work is put together hand it over to the customer Not only tumblers and triggers, but even sears and tubes are finished up in this manner. As these parts are almost always made of soft iron, the result is they soon wear and have to be repaired

The gunsmith who does good work will thoroughly case-harden the parts when they are fitted and finished, and by so doing will turn out a really good piece of work that will wear as well as hardened steel. Why the majority of the trade do not case-harden their work cannot very well be explained, unless they are ignorant of the process or do not care to be put to the trouble of doing it. It is true it may be made a tedious job or a quick and easy one.

Some gunsmiths, when such work is finished, heat it red hot, smear it with prussiate of potash or cyanide of potassium, and while hot, plunge it into cold water, letting it chill. This produces a superficially hardened surface that is not "skin deep," and as soon as this surface becomes abraded will wear away rapidly.

If the case-hardening of the expert manufacturer be examined, it will be observed that the surface of such work has a fine grayish appearance, and in many places mottled with colored tints that are pleasing and beautiful to the mechanical eye. It will be further observed that the hardening is of such depth that it will wear for a long time. In fact it will wear better than hardened steel. The condition of the material is that of a hardened steel surface stretched over and shrunk upon the iron body of the work. It is stronger than steel, for it has the tenacity of iron for its interior. It has the advantage of steel, inasmuch as it may be bent when cold to a limited degree, and when so hardened will not break as readily as steel. This property of bending is not confined to all articles, as they may case-harden entirely through, and then they will be very brittle and easily broken, but by drawing them to temper after hardening, in the same manner as a tool is drawn to temper, they may be of any hardness desired.

A good way to Case-Harden.—The easiest and perhaps the best way to case-harden gun work is to have a number of short pieces of common gas pipe, such as will be adapted to the size or quantity of the work, and have one end of these pieces securely plugged or closed. One way will be to heat the pipe and close by flattening the end with a hammer on the anvil, but it is a "slouchy" way of doing it. A neater way is to have a gas fitter cut a thread in the pipe and then screw in a plug, such as are used to close ends of gas pipe; if such cannot be obtained, drive in a cast iron plug and upset the end of the pipe so that it will not readily come out In these pieces of pipe place the work, packing it well with good, fine bone-dust, such as is used by farmers for fertilizing land. Be careful to so pack that the different pieces of work will not touch each other. Stop the open end of the pipe with a cover, but in such a manner as to be readily opened; place the pipe and its contents in a good fire, letting it remain at a red heat for fifteen minutes or more, dependent upon the thickness of the articles or the depth they should be hardened. Remove from the fire and quickly empty the contents of the pipe into a pail of cold water.

If pieces of gas pipe cannot very well be obtained, thimbles from old carriage hubs may be used instead. Plug up the small end, fit a cover to the large end and use as if it were gas pipe. As these thimbles are made of cast iron they will not bear the rough usage nor the heat that wrought iron will withstand. Common cast malleable iron makes the best receptacles to contain work for case-hardening

Articles of malleable iron and cast iron are as easily case-hardened as wrought iron. A poor quality of steel is benefited by the operation, as the metal imbibes carbon in which it was before deficient.

Material for Case-Hardening.—For case-hardening, bone-dust is the article most readily obtained and it is clean and neat to use; but it will not produce the mottled tints that charred or burned leather will give. The leather may be prepared by cutting up old shoes or boots, putting them in an old pan and setting the mass on fire. Let it burn until it is a charcoal that will readily crumble in pieces by using a little force. Grind this charcoal to a fine powder by pounding in a mortar or by running it through an old coffee or spice mill. Pack the work with the powder, the same as bone-dust. Bone black may be used the same as bone-dust, but it is not very satisfactory in its results. It is also dirty to use and to have around a shop. Ivory dust will also answer the same purpose as bone-dust. Gun guards, straps and long pieces of work will become shorter by case-hardening, and it is best not to fit such pieces into the stock until after they are hardened. If it be desired to have a portion of the work left soft and the other parts hardened, securely cover the places to be left soft, with a coating of moist clay, and this will prevent the hardening material from coming in contact, and, consequently, it will have no opportunity to absorb carbon and harden when put in the cold water.

It may also be observed that articles that are case-hardened will not rust so readily as those not so treated.

If the articles be quite thin and there be danger of them cracking by sudden chilling, the water may be warmed a little, or a film of oil may be spread on the water which will tend to prevent a too sudden contraction of the articles while cooling

If it be desired to have the work present the colors or mottled tints as seen on some kinds of

case- ardened gun work, the surface of the work before being put in the receptacles containing the burnt leather, must be nicely polished and then buffed or burnished. The higher the finish the more brilliant will be the colors.

In using prussiate of potash to case-harden, the potash must be finely powdered, the work heated and dipped in, or if the work be large the potash must be spread over it. The work must be hot nough to fuse the potash, and if it become somewhat cold by removing from the fire it must be reheated, removed quickly from the fire and quenched in cold wa' r.

Another way to Case-Harden.—Collect such articles of animal origin as cows' horns, or hoofs of either cows or horses, or leather trimmings from about the shoe-shops, or old cast off boots or shoes, and burn them until sufficiently charred to admit of being easily pounded into a powder. Having finished up the article to be hardened, ready for the final polish, place it in an iron box, and surround it completely on all sides by a packing of the powder. Pour into the box, until the powder is made moist, a saturated solution of common salt in urine. Next close the box and seal it until airtight, with wet and well-worked clay, then put it into the furnace and blow up gradually until heated to a cherry red. Don't run the heat any higher, but hold it at that about five minutes, then take out and plunge at once into the slack-tub.

By this means a piece of soft malleable iron is rendered as hard as hardened steel. Some workmen contend that the salt solution is of no particular importance—that just as good results will come of packing in the animal charcoal alone. The iron box, though very convenient when a good deal of case-hardening is to be done, is not an absolute necessity. If the article, surrounded by the animal charcoal, is incased in a ball of stiff and well-worked clay, and then exposed to the proper heat and slacking, the results will be the same as if heated in an iron box.

Another Formula.—In earlier times, when guns were more in use than either agricultural or mechanical implements, and there was a gunsmith's shop at almost every cross-road, they had a way of case-hardening that was much more simple than either of the foregoing, and yet quite effectual. Scraps of old leather, as cut from old boots or shoes, were tightly wrapped and tied around the piece of iron to be made hard, to the extent of several thicknesses. Around this was placed a layer of sand and salt in equal proportions, to the thickness of half an inch. The sand and salt was dampened with water to make it stick together. A layer of plastic clay, an inch in thickness, was worked around the whole, and the ball, so made, was exposed to heat at about the cherry-red degree, sufficiently long to consume the leather, when it was dropped suddenly into the slack-tub.

Still Another Formula.—Make a powder of pulverized prussiate of potash, sal-ammoniac and saltpetre in equal parts. Heat the iron to cherry-red and sprinkle thoroughly on all sides with the powder, then immediately plunge into the slack-tub.

Some smiths contend that the pulverized prussiate of potash, used in the same way, is entirely effectual without the other ingredients.

To Chill Cast Iron.—Make a powder by pulverizing together, salt, 2 lbs; saltpetre, ½ lb; alum, ½ lb.; ammonia, 4 ozs., and salts of tartar, 4 ozs. Heat the iron to cherry-red, sprinkle thoroughly with the powder and then plunge into cold water.

Another Mode.—Make a solution by dissolving in 10 gallons of soft water, salt, 1 peck; oil vitrol, ½ pint; saltpetre, ½ lb.; prussiate of potash, ½ lb, and cyanide of potassium, ½ lb. Heat the iron to cherry-red and plunge at once into the cold solution. This makes cast iron hard enough to cut glass, and is the method usually resorted to for hardening the cheap cast-iron glass cutters, now so common on the market.

To Soften Wrought Iron.—Heat the iron with a slow blast to a dark-red, then pour upon the burning coals half a pint of fluoric acid. Keep up the blast gently, without increasing the degree of heat, until all sign of the acid has disappeared, then lay out the iron to cool gradually of itself.

Alloy for Filling Holes in Iron.—Melt together nine parts lead, two parts antimony and one part bismuth. Pour into the hole while in a moulten state, or drive in while the iron is somewhat hot. This alloy possesses the peculiarity of expanding as it cools, consequently the plug tightens as its temperature falls.

To Harden Iron for Polishing.—Pulverize and dissolve the following-named articles in one quart of boiling water: blue vitrol, 1 ounce; borax, 1 ounce; prussiate of potash, 1 ounce; charcoal, 1 ounce, and common salt, ½ pint. Add to this 1 gallon raw linseed oil. Having finished up the article ready for polishing, heat it to a cherry-red, and plunge into the mixture; a rapid stirring of the mixture should be going on at the time when the plunge is made.

This preparation hardens the iron to such a degree that it takes and retains polish almost equal to the best of steel.

CHAPTER XI.

On Working in Steel.
Hand Forging Steel
Welding Steel
Tempering
To Restore Burnt Steel
Annealing Steel
To Blue Steel
To Remove Blue Color From Steel
Tempering Knife Blades
The Lead Bath for Tempering
Test for Good Steel
Etching on Steel

CHAPTER XI.

ON WORKING IN STEEL.

Hand-Forging Steel.—In the main this does not differ materially from the same work in iron. Special care must be exercised to have the fire clear of sulphur, hence charcoal is the best fuel to use. In cases where the use of bituminous coal cannot be avoided, the fire should be blowed up for several minutes before putting in the steel, to drive off the sulphur.

Steel to be forged should not be heated to so high a degree as is employed for iron; for ordinary light work a little above a cherry red is enough. It does not work well under a high degree of heat; and, to make amends, it can be worked much colder than iron. In fact, it is always best to hammer it with light blows until the red color of the heat has entirely disappeared, as this improves its texture by adding decidedly to the closeness of the grain.

Welding Steel.—The common method employed for welding iron to iron is often resorted to for welding steel to steel, but a great deal more care is necessary to success in the latter than in the former case. There must be much precision so far as relates to the rate of heat, as the margin for variation is extremely small. If the temperature is not high enough there will be no adhesion, of course; and if it attains to only a few degrees above what is actually necessary, the steel either "runs" and is ruined, or is ruined by going into an unworkable condition known as "burnt." It sometimes becomes necessary to weld steel and iron together; this may be effected by the same process as that employed in welding steel to steel. None but workmen of thorough experience would be apt to succeed in either case, on the old plan of proceeding the same as in welding iron to iron.

But steel may be more easily welded than on the old plan by the employment of certain welding compositions. One of them consists of half a pound of saltpetre dissolved in half a pound of oil of vitriol, and afterwards added to two gallons of soft water. Heat the pieces to a cherry-red, then plunge them into this composition; after which proceed to reheat and weld in the usual way. At the welding the strokes of the hammer should be quick and light.

Another composition is made by pulverizing together ten parts of borax and one part of sal-ammoniac. Thoroughly melt the composition so made in an iron pot, then pour out upon some level surface to cool. When cooled grind to a fine powder. Heat the pieces of steel and sprinkle this welding powder over them; then return to the fire, and again heat up, and it is ready to go together under the hammer.

Some smiths claim to weld steel successfully by dusting over the heated pieces a powder composed of clear white sand, 2 lbs., and plaster of Paris, 1 lb.; then reheating and proceeding in the usual way.

In welding steel to iron the foregoing processes are employed the same as if both pieces were steel.

Tempering.—Heat the steel to a bright cherry-red, and plunge it at once into cold water. It will then be as hard as fire and water could make it, and too hard for anything except hardened bearings for machinery, or for some kind of implements necessary to be extremely hard, as tools for cutting glass, and the like. In this condition it is almost as brittle as glass itself and hence would not stand for most of the uses to which tempered steel is applied. Its great degree of hardness must, therefore, be reduced to the proper standard, depending upon what it is to be used for. This is done by heating and closely observing the resulting colors as they appear upon the metal. If the piece under process is an edge-tool of considerable bulk, only the cutting-edge, and a little back of it, is plunged into the water at the hardening, the rest of the implement being left still hot. It is then held into the light and observed closely, when the different colors, indicating the different degrees of hardness, will be seen moving slowly, one after the other, down towards the edge, driven by the heat still left in the part of the metal not plunged. When the color wanted has reached the edge, the entire piece is plunged into the slack-tub, which stops further action of the heat, and establishes the required degree of hardness exactly where it is desired. But very light articles and implements cannot be tempered in this way, as they will not retain sufficient heat to drive the colors; it will be necessary to reheat them gradually in some way to make the colors move. Very light pieces, as drills and the like, are best tempered in a spirit or alcohol lamp; after having been hardened they should be held in the flame of the lamp a little back of the point or cutting-edge, which will enable the operator to note the movement of the colors. In this case his actions, so far as the colors are concerned, will be governed the same as in the other. Small articles to be tempered alike all over may be placed upon a bit of sheet-iron, after hardening, and the iron held over the fire of the forge, or directly over the flame of the lamp, until the required color has appeared, when they must be quickly plunged into the water. On large articles the colors will be often so strongly marked as to be readily seen on the surface of the metal, rough, just as it came from the hammer, but in small articles they will be somewhat faint; hence it is best to give small articles a slight polish before exposing them to heat for drawing the temper. Nine shades of color will present themselves one after the other as a piece of thoroughly-hardened steel is exposed to gradually-increasing heat. They are:

1. Very faint yellow, appearing at a temperature of 430° Fahrenheit. If slacked at this color, the piece will be very hard, having a temper admirably suited to drills for working in hard metals or hard stone.

2. Pale straw-color—450°. Still very hard, suitable for the faces of hammers and anvils.

3. Full yellow—470°. Shears and scissors.

4. Brown—490°. Gravers and turning tools for hard metals; also percussion-lock gun tubes.

5. Brown, with purple spots—510°. Wood working tools and most of the steel parts in a gun-lock with the exception of the springs; also knives of all sorts for cutting wood.

6. Purple—538°. Butcher-knives and other flesh-cutting implements.

7. Dark blue—550°. Tools requiring strong cutting-edges without extreme hardness, as case-knives.

8. Full blue—560°. Chopping-axes.

9. Grayish blue, verging on black—600°. Springs, saws, swords, and the like.

Various other methods of tempering steel are sometimes recommended, as with oils, tallow, lead, mercury and divers solutions; but since the matter-of-fact gunsmith will find use for none of them, it is not deemed proper to encumber this book with anything further on the subject of tempering. It might be well to state, however, that the hardest degree to which steel can be brought is secured by heating the piece to a light yellow and instantly plunging it into cold mercury.

To Restore "Burnt" Steel.—Pulverize together two parts horn or hoof filings; one part sal ammoniac; one part charcoal, and one part common soda. When thoroughly ground together, work in tallow enough to make a kind of wax or paste. Bring the damaged steel to a bright cherry-red heat, and then cover with the paste, leaving it to cool gradually. The process may be repeated several times with profit if considered necessary. While a piece of badly-burnt steel may not be entirely restored by this process, it can be much improved. Entire restoration is scarcely possible.

Annealing Steel.—Heat the steel to a cherry-red in a charcoal fire, the last thing to be done before quitting work at the forge for the day or night; then smother the fire down with a thick layer of ashes or sawdust, leaving the steel in, just as heated. Let so remain until the fire is all out, and the steel entirely cool, which will require several hours. Some smiths use a piece of gas-pipe in which to heat small steel articles for annealing, claiming that it is very advantageous. They put the piece into the pipe and heat to a cherry red, looking in occasionally to ascertain when it has attained to that temperature; then they cover the fire, pipe and all, and leave it to cool as in the other case.

To Blue Steel.—Polish the article to be blued, then place it upon a strip of sheet iron and heat slowly over a forge fire or lamp, until the desired blue color appears. Let cool, and the color will remain permanent.

To Remove Blue Color from Steel.—Immerse for a few minutes in a liquid composed of equal parts muriatic acid and oil of vitriol. Rinse in pure water and rub dry with chamois skin or some kind of soft cloth.

Tempering Knife Blades.—To heat the blades lay them in a clear charcoal fire, with the *cutting edge downwards*, and heat very slowly. It is not particular if the back of the blade, which is *uppermost*, is so very hot or not. Harden in clean luke warm water. If many blades are to be hardened at once, lay a number in the fire and remove one at a time as they are properly heated. To temper, brighten one side on a grindstone or emery wheel so that the temper color can be seen, and lay the blades in the fire, or on an iron plate heated over the fire, with the backs *down* and the cutting edges *uppermost*. On the plate place wood ashes or fine sand to help keep the blades in proper position, and also facilitate even drawing. When the proper color is seen on the brightened portion of the cutting edge, remove and cool in cold water

When an extra tough blade is wanted, after it is hardened, handle it so that it will not draw any lower after removing from the fire, and let it cool without putting in water.

Long blades, when they are being drawn, can be straightened, if necessary, by putting them between two pins in the anvil or pins fixed in an iron block and bending between these until straight, wetting the blade with a cloth or sponge saturated with water, when the blade is thus straightened. Surprising as it may seem, when hardened steel is being drawn, it can be bent to quite an extent, and when cooled will remain as bent. File makers straighten files in this manner. Sword blades and blades of butchers' knives undergo the same process of manipulation to be made straight.

The Lead Bath for Tempering.—Among the many secrets of tempering is the employment of the lead bath, which is simply a quantity of molten lead, contained in a suitable receptacle and kept hot over a fire. The uses of this bath are many. For instance, if it be desired to heat an article that is thick in one portion and thin in another, every one who has had experience in such work knows how difficult it is to heat the thick portion without overheating the thin part. If the lead bath be made and kept at a red heat, no matter how thick the article may be, provided sufficient time be given, both the thick and thin parts will be evenly and equally heated, and at the same time get no hotter than the bath in which they are immersed.

For heating thin cutting blades, springs, surgical instruments, softening the tangs of tools, etc., this bath is unequaled.

If a portion of an article be required to be left soft, as the end of a spring that is to be bent or riveted, the entire may be tempered, and the end to be soft may be safely drawn in the lead bath to the lowest point that steel can be annealed without disturbing in the least the temper of the part not plunged in the bath. Springs, or articles made of spring brass, may be treated in the same manner. One great advantage in using the lead bath is that there is no risk of breakage or shrinkage of the metal at the water line, as is often the case when tempered by the method of heating and chilling in cold water

As lead slowly oxidizes at a red heat, two methods may be used to prevent it. One is to cover the surface of the lead with a layer of fine charcoal or even wood ashes. Another and a better plan, when the work will admit of its use, is to float on the top of the lead a thin iron plate, fitting the vessel in which the lead is contained, but having a hole in the centre or on one side, as most convenient, and large enough to readily admit the articles to be tempered or softened.

Test for Good Steel.—Break the bar of steel and observe the grain, which in good steel should be fine

and present a silvery look, with sometimes an exfoliated or leaf-like appearance. One of the best tests of steel is to make a cold chisel from the bar to be tested, and when carefully tempered (be careful not to overheat), try it upon a piece of wrought iron bar The blows given will pretty correctly tell its tenacity and capability of holding temper. Remember the temper you gave it, and if it proves tough and serviceable, take this temper as a guide and temper other tools in like manner. Inferior steel is easily broken, and the fracture presents a dull, even appearance, which may very appropriately be termed a lifeless look.

Etching on Steel.—Make an etching solution by pulverizing together sulphate of copper, one ounce; alum, one-quarter ounce, and common salt, one-half teaspoonful. Add one gill strong vinegar and twenty drops nitric acid. Stir till thoroughly dissolved. Polish up the metal to be etched, and then cover its polished surface with a thin coating of bees-wax. This can be accomplished with neatness by simply heating the metal till the wax flows evenly over its surface. Now draw upon the wax, cutting cleanly through to the steel the figure you wish to etch; then cover the figure so prepared with the etching solution, and let stand for a short time, depending upon the depth of cut desired. Finally rinse off with clear water, and then remove the bees-wax. It will be found that the solution has cut into the surface of the steel wherever exposed, leaving untouched all parts covered by the wax.

Very good etching can be done by applying, on the foregoing plan, nitric acid alone. Etching offers a good method of cutting a man's name on his gun or pistol. It works on silver or brass the same.

CHAPTER XII.

On Working in Silver, Copper and Brass. .....
To Forge Silver.....
To Polish Silver.....
Light Plate for Copper or Brass.....
To Clean Silver.....
To Work Copper.....
To Work Brass.....
To Cast Brass.....
To Braze Iron .....
To Clean Brass.....
To Solder Brass.....

CHAPTER XII.

ON WORKING IN SILVER, COPPER AND BRASS.

To Forge Silver.—The gunsmith will not have much to do with silver in the work of his trade, though instances may occur now and then when he will be called upon to make or repair mountings or ornaments for gun-stocks formed of this metal, and also foresights, particularly for the old fashioned Kentucky rifle.

In shaping silver under the hammer no heat will be necessary at the hammering—it would do no good. The metal is so malleable that it may be drawn into almost any shape by simply hammering cold. The only trouble liable to come up in this kind of work will be the hardening of the metal under the influence of the hammer; but this trouble may be pretty effectually removed by heating the silver to redness, and then letting it cool gradually of itself. Care must be taken not to heat it too much above the first appearance of red, as it melts quite easily.

To Polish Silver.—File it down to the shape desired, then dress with a fine file; then work over thoroughly with a burnisher. Next buff it off with rotten stone, and if a particularly fine finish is desired buff again with rouge.

Light Plate for Copper or Brass.—Dissolve silver in nitric acid by the assistance of heat; put some pieces of copper into the solution and immediately the silver will be precipitated. With fifteen or twenty grains of the precipitate thus obtained mix half a drachm of alum and two drachms each of tartar and common salt. Pulverize well together Having thoroughly cleaned the surface to be plated, rub it well and hard with the mixture, using a bit of chamois skin, until it presents a white appearance. Next polish off with soft leather until bright.

Inferior as this kind of plating would seem, it will wear a long time.

To Clean Silver.—Wash with a little spirits of ammonia reduced in strength by twice its bulk of pure water, then rub dry and bright with soft leather. No kind of polishing powder will be necessary. Some workmen clean silver by first washing it over with diluted muriatic acid, then immediately covering the surface with dry prepared chalk, then brushing off and rubbing clean with a bit of chamois skin. It acts very well, but care must be had to get the acid thoroughly cleaned off else it will have a tendency to soon tarnish the silver.

To Work Copper.—This metal is almost as malleable as silver, and works very well under the hammer in a cold state. Heat adds nothing to its malleability, though, as in the case of silver, exposure to a low degree of heat, followed by gradual cooling, softens it somewhat when it has been rendered hard and brittle by long hammering. It polishes very well, but does not long retain its polish and brilliancy on account of its disposition to oxidize. Heating increases its oxidation; repeatedly heating and cooling would soon wear it entirely away.

To Work Brass.—This material is a combination of copper and zinc, and since zinc is not so malleable as copper, it renders the brass less malleable. Nevertheless it forges out pretty well under the hammer, in a cold state, the only condition in which it can be so worked. Hammering increases its hardness with great rapidity, soon converting it into a very fair spring metal. Brass springs are quite common—they are all made by repeatedly hammering or rolling the metal while cold. As in the case of both silver and copper, heating and gradual cooling removes this hardness. This is the plan for softening usually recommended in books on working metals, but no advantage will be found to arise from the gradual cooling in the case of either silver, copper or brass. The custom is to heat the metal to

the lowest degree that would show redness and then plunge it directly into cold water.

To Cast Brass.—The gunsmith may occasionally find it necessary to cast something in brass. This he can do without trouble, as brass melts quite easily. The mould should have vents at or near the top to admit the free escape of air as the molten metal runs in to take its place; and it is always best, if possible, to arrange so that the metal will enter the mould near the bottom and rise up in the filling Without such an arrangement there is danger of air bubbles remaining under the metal and spoiling the casting. The metal should be heated only to a degree high enough to admit of flowing freely and no higher.

To Braze Iron. — Clean and polish the iron thoroughly, being extremely careful not to touch its surface with the fingers at the finishing; then plunge it into molten brass. Take out immediately; a thin coating of brass will be found covering the iron, which may be polished or burnished, giving the article the appearance of solid brass.

To Clean Brass.—To half a pint of soft water add one tablespoonful of oxalic acid. Wash the article with this, then cover with prepared chalk, brush dry and polish with chamois skin, as in cleaning silver. The solution may be bottled and kept on hand for use as wanted.

To Solder Brass.—The processes in soft soldering are the same for all metals, full instructions for which may be found in Chapter XXXIV. Hard soldering (see also Chapter XXXIV) is something different, and in the case of brass it is somewhat different on account of the low degree of temperature at which the metal melts. The solder most commonly used is composed of two parts of common brass and one part of zinc, melted together. Reduce your solder to fine bits by cutting or filing, and then mix with sal-ammoniac and borax, the two latter having been pulverized together in equal parts and moistened with water to form a kind of paste. Carefully clean the pieces to be joined, lay them together, place the soldering compound along the upper edge of the joint, which must be held vertically, and then heat gradually over a charcoal fire until the solder is seen to run down between the pieces. The instant the solder is seen to run remove the work from the fire, tap the work gently with a small hammer to jar the solder into all interstices, and, if the work be so that it can be done, scrape off the superfluous solder and burnt borax with an old file.

CHAPTER XIII.

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CHAPTER XIII.

ON WORKING IN WOOD.

The Woods Most in Use.—Various woods are now employed for making gun stocks, but among them all, the most popular, perhaps, is black walnut. It is deservedly so from the fact that it is light, works easily, takes a superior polish, has a rich dark color, naturally, and when finished up does not incline to "check." So popular is it, indeed, that most of the other woods worked into gun stocks are stained and finished up to imitate walnut.

In some portions of the country hard or sugar maple ("sugar tree") is worked quite extensively by the local gunsmiths. It makes a very nice stock, finishing to good advantage, especially "curled maple," which is really beautiful. Soft maple is also extensively used, stained and finished to imitate either hard maple or walnut.

The common dogwood makes an excellent gunstock, but it works badly on account of the smallness of the tree rendering it difficult for one to get the pieces sawed out in proper shape at the beginning. Holly also makes a good stock, but presents the same objection as the dogwood. Cherry has few superiors, but it is now becoming a very scarce wood. Sweet gum is getting to be quite extensively used for cheap guns, stained to imitate either walnut or cherry. It has fine grain, and works very well, the chief objection to it being that it is wonderfully inclined to warp.

Wood for Gun Stocks.—The wood for a gun stock should combine strength and lightness, and at the same time it is desirable that it be easy to cut. The fibres of the wood should be close and possess great cohesion and should be little liable to split.

In this country black-walnut is generally selected for shot guns, and either black-walnut or hard maple for rifles. The grain of the wood should be straight at the small of the stock, which is the weakest portion of the work. Between this and the end of the breech it little matters how the grain runs. If there be curls, waves or a hard knot, let it come about midway between the small and the end of the butt. As the wood at this place is simply "rounded" it is easy to work it into shape, as the shape given to it is such that any deviation of the fibres or grain from a straight line can be shown to the best advantage, also at this place there is less demand for strength of wood than at any other part of the gun stock. Around the small it is very necessary that the grain be straight and run in the direction of the shape given and also continue straight until past the place where the locks are set in. A little distance in front of the barrel breech it matters but little how the grain runs, but if the fibres of the wood where the barrel is let in run toward the breech it will be found to be easier to work out for the reception of the barrel. For then as the tools are worked toward the breech they are cutting *with* the fibres or grain and not *against* it. But as the majority of guns are now half-stocked the distance to cut in order to let in a barrel is so small that but little attention need be paid to the grain at this spot.

The best and most serviceable stocks are those made from parts of the tree where large branches

join the trunk. In these parts, too, will be found the curled and irregular grain that is so much admired when the stock is so made that these irregularities come in the stock a little in front of the butt plate. When large trees are cut down, it will be observed very often that there are portions of the stump that have a kind of convex form, and extending downward terminate in large roots. If these be dug out or separated from the stump by splitting them, they are almost always of a proper shape, to have the grain run nearly straight in the curves as given to the stock. In black-walnut and hard maple these root portions are very firm of fibre, quite hard and have a splendid grain that finishes up beautifully. Portions of some root pieces have a mottled appearance and are of a different color from the wood as cut from the trunk of the tree; this is especially the case with black-walnut. As these stumps can be had by the trouble of removing them, the gunsmith can very cheaply secure pieces of wood that are very valuable. Oftentimes black-walnut stumps are found floating in the water, and on the banks of western rivers, that are perfectly sound and so darkened by water soaking that they make beautiful stocks.

The dryness and fitness of the wood may be ascertained by the easy crumbling of the shavings and by the dryness of the sawdust. It is necessary that the wood be well seasoned, for if any moisture or sap remains in it, the barrel and portions of the lock that come in contact with the wood, will in a short time be covered with rust.

CHAPTER XIV.

On Gun Stocks.
Form of Gun Stocks
Dimensions for Single Gun
Dimensions for Double Gun
Laying Out Gun Stocks
How to Stock a Gun
The First Operation in Stocking
[illegible] the Barrels
[illegible] the Stock
The Butt
[illegible] the Locks
[illegible] the Trigger Plate
[illegible] the Trigger
[illegible] Fastenings
[illegible] Rib Loops
Gun by Finishing
Fitting the Break-off
To Let in Escutcheons
How to Cast Tips on Fore End of Stock
Chequering
Coloring Gun Stocks
To Stain a Maple Stock
Another Method
To Color a Maple Stock Brown
To Color a Reddish Brown
To Color Black
Rosewood Stain
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Mahogany Stain
Cherry Stain
Oil Finish for Gun Stocks
Varnishing and Finishing
The Varnish for Gun Stocks
The Varnish Can

CHAPTER XIV.

ON GUN STOCKS.

Form of Gun Stocks.—When a customer orders a stock to be made, or has a gun to be re-stocked, the gunsmith will observe the length of his customer's arms, length of neck, his height and general carriage. From these he can gather some data as to the length and form of stock to be made. Give him a gun, and observe his mode of raising it and taking aim, and the manner of his holding his head while aiming, and deductions may be drawn as to what the customer requires.

A tall, long-limbed and long-armed man requires a longer stock than a shorter person, and a straight stock will better answer for a short-necked, high-shouldered man than for a long-necked, low-shouldered person. A straight stock is much more suitable for a short-necked, high-shouldered person than a bent one, and for this reason, that, in fast shooting the point of sight at the end of the gun would come up to the range of the eye before the butt could be placed full against the shoulder, and one consequence would be, when fired, a severe recoil of the gun at every discharge. A stock rather long is much better than one too short, and one rather crooked to one that is too straight. If a gun be not held on a perfect level, but the muzzle higher than the breech, the load will be carried over the object aimed at, supposing that object to be on a level with the eye. Let a customer take a gun, such as would be thought to be best suited to his "build," and request him to close both eyes and raise the gun to a level, as if to shoot thus. Have him hold the gun immovable thus, and then request him to open his eyes, and it is evident if he requires a stock to be made different from the one he has in hand. If the face comes naturally to the breech and the eye has a "fine sight" along the barrel, it is just the pattern of gun stock for him to have. If it be too straight he will shoot over, if too much crooked he will shoot under. In the first instance the muzzle is brought too high by an effort of the face to find a position at the breech, and in the other case it so readily finds a place that no further effort is made, except by practice, to raise the muzzle to the proper level.

A tall, slim person requires a gun with a long, crooked stock, and rather heavier and made fuller behind the small, as this will fill up his want of a full face, and will better permit his eye a command of sight along the middle of the barrels, supposing the gun to be a double one. For a short individual a short, straight stock is required, and it should be made thinner behind the small, so as to easily permit access to the line of sight. If a person be in the habit of firing too low and behind a bird, if the stock be made a little straighter it will prove a remedy for the fault.

That part of the stock where the cheek comes to rest should be full, as it gives more support to the line of fire. The heel of the stock should be in a straight line with the upper rib between the barrels. If a single gun, on a line with the barrel. The length of stock from the centre of front trigger to centre of butt-plate, from thirteen to fifteen and a half inches; a short person requiring the less measurement, while a very tall one might require the

longest one.

The cut, Fig. 23, gives a better idea of what the stock should be. Place a rule or straight-edge upon

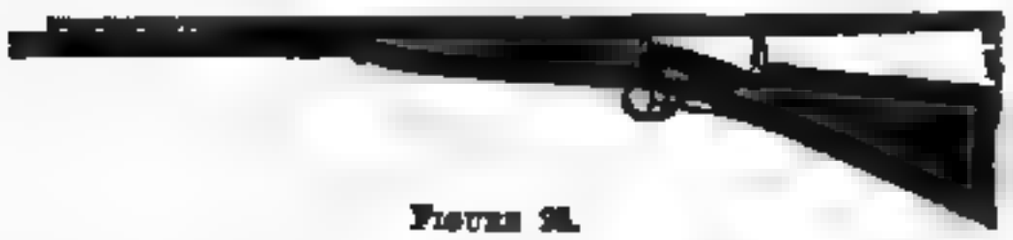

FIGURE 23.

the rib of the gun, and long enough to reach from the sight of the gun over and beyond the butt. Be particular that the straight-edge lies along the rib and touches it at both muzzle and breech. The measurement from *a* to *b* on the butt is what is termed the "drop," and this may be from two and a half to four inches, according to the requirements of the shooter. The cheek of the sportsman comes between *c* and *d*, and almost always touches the stock at this place when bending his head forward over the stock of his gun to take the line of sight. This part of the gun should command particular attention.

Another point of considerable importance to observe is, that a due regard be paid to the proper fall of equipoise or centre of gravity of the gun when stocked and ready for use. This centre of gravity should fall at a point about two feet two inches, or perhaps an inch more, from the heel of the butt. In this case the arm is easier to handle and easier to carry. If the breech be too light, lead may be inserted to advantage in the butt, the butt-plate being removed for that purpose.

Dimensions for Single Gun.—The following may be considered very good dimensions for a single gun stock: Whole length of stock, from butt to cap, two feet two inches; length or depth of butt, five and a half inches, with a trifling concave surface; width of stock at butt, two inches; from point of centre of the lock-tumbler to cap, eleven inches; width of stock before the guard, one inch and three-eighths, and made nearly square.

Dimensions for Double Gun.—For a double gun: Length of stock, from butt to cap, two feet one inch; length or depth of butt, five and a half inches, with a slightly concave surface two inches in width; from centre of lock-tumbler to cap, ten and one-quarter inches; width of stock before guard, one inch and three-quarters, and made nearly square.

Laying out Gun Stocks.—Several patterns each, of double and single, and rifle stocks are necessary. These patterns may be made of thin wood or thick straw board. These patterns ought to be a little larger than the finished stock, and are intended only for a proximate measurement of the stock when to be sawed from the rough wood. Select the wood, lay the pattern upon it, mark around with a pencil or crayon, and then saw out by the lines made.

With a plane, smooth one side of the wood so as to show the grain and the direction in which it runs. This must govern the position of laying the pattern. The weakest portion of the stock is the small, and there it is almost a necessity that the grain should not run across the line of the stock, but with it. If a very little divergence be made, it may not matter, provided the wood be of a hard and close grain. If the grain run across, or at an angle at this weakest spot, a slight blow or accidental fall is liable to cause a breakage which can best be repaired with a new stock. If the wood be in some places mottled, with curled or twisted grain, or has a knot that is hard and sound, let this spot come in the center of the butt, for by its width and thickness no accident is liable to break it, and the rounded form gives opportunity to show off the irregular grain to good advantage. Let the wood where the butt plate is attached be of straight and regular grain if possible. The grain where the locks are let in, and also where the barrel is let in, should be straight and run in the same line as the barrel.

The planks or rough pieces for double gun stocks should be about two and a quarter inches thick before they are reduced. Two inches for a single gun, and about one and three-quarter inches, or a little thicker, for rifles, depending on their weight and the taste of the customer.

It is best to have a number of stocks roughed out. Maple for rifles and black-walnut for single and double guns. Let them lay in a dry place to thoroughly season, and if they remain in this manner for several years, they are all the better for it. It is claimed that it takes seven years for a plank to season, and even then when sawed into stocks, they will be observed to shrink and change form, and often small cracks will appear.

Unhesitatingly reject all pieces that are unsound, or have any appearance of being brash, or with any signs of decay. Often in laying the patterns upon the wood these places can be readily avoided, and thrown away as the plank is cut up. Draw a straight line where the barrels will come, and cut to this line, but be sure to leave plenty of wood where the breech of the barrels rest, and where the break-off is set in. When the stock is roughed out, this spot will have the appearance of a rise or swell with a sharp curve in front, down on to the line which is just below the centre of the line of the barrels for double guns, and on the centre for single guns and rifles. Except in the case of some who may fancy the old Kentucky rifle, all guns will probably be made with half stock. It would be hardly advisable to keep only a very limited stock of full length stocks on hand. If such are to be roughed out, pay particular attention to have the grain of the wood as straight as possible the full length where the barrel is to be let in.

How to Stock a Gun.—Stocking a gun is the most difficult portion of the gunsmith's trade. The change from iron work to the manipulation of wood is so great that many workmen refuse to work at both branches of the business. Then again, if the stock be not well done and the parts well fitted, they show a greater per cent. worse than perhaps they

really are. The letting in of the barrel and locks should be done with care and nicety, and no apparent openings between wood and metal should be visible. The parts should be closely adherent to the wood, yet easy to be removed and returned to place. Where straight lines of the wood work are required, as along the line of the barrels and other places, let the lines *be straight*. Where the convex lines of the breech and butt occur, let the lines be graceful and of even proportions.

The First Operation.—After receiving the rough formed stock, as roughed out for seasoning, the first thing to do is to plane it to a thickness, and there are two places to measure for this thickness. One is the thickness of the butt, which in double guns may be two inches, and the same width in heavy single guns, and a trifle lighter if it be a light gun. The other place for measurement is across where the locks are to be let in. Observe how the locks are to rest, against the break-off or against the barrels. Note this measurement and add the thickness of the locks. This may be an inch and three-eighths to an inch and a half for single guns, and an inch and five-eighths to an inch and three-quarters for double guns, yet as the formation of the breech and style of locks differ so will these measurements vary from the measurements given. When these measurements are made, and the stock reduced to the proper width, draw a line both on the upper side of the stock as well as the under side, exactly between the breech and lock measurements, and continue this line from the end of the butt to the end of the fore-stock. Cut down to a straight line the stock where the barrels are to be let in, and fit in the break off. Take pains to fit it well, for on the fitting of this in a great measure depends the life of the stock. If the barrels be loose fitted, each recoil of the gun on firing tends to loosen the break-off from the barrels, and the joint soon becomes open and shackling.

When this part is snugly fitted and the strap let in, put in temporary screws to hold it for a season. Cut out the groove for the barrels, keeping in mind all the time that the central line between the barrels must be on the line as drawn on the centre of the stock. If a single gun, this line must pass directly through the axial line of the bore.

Letting in Barrels.—When it is thought that wood enough has been removed to admit the barrels, rub oil on them on the under side where they come in contact with the stock, put the hooks in the break-off, and with the hand press the barrels to place—the oil will show on the wood, on removing them, and then, with gouge or float, remove this portion and again put the barrels in place, observing the oil marks, and reduce the wood again until the barrels lie in their beds evenly and solidly, and the joining at the break-off is in place, square and true. The heel of the stock should come in a straight line with the middle of the rib, and will come so, if observance of the lines first drawn has been made.

Measure for the Stock.—Now measure for the drop of the stock, which is illustrated in Fig 23. From the line *a* to *b*, which is a continuation of a line along the top of the barrels, may be, for instance about three inches. Cut the stock away on top to this measurement, and fit on the butt plate. To get the length of the breech, measure from the spot where the end of the front trigger will come, and this measurement extended, straight back to the centre of the butt, gives the length. For a person with long arms about fifteen and a half inches is enough; about fourteen and a half for a person with ordinary length of arm, and thirteen and a half or thirteen and three-quarters for a person with short

The Butt.—The depth of the butt for a double or single may be about five and a half inches, but for a light single gun a little less but not very much.

Letting in the Locks.—The locks should now be let in their proper places, and, while so doing, have great care that no more wood be removed than is necessary. See that the lock-plates have all the support possible where they fit into the wood. Cut out enough for full play of the mainspring and sear-berg spring carefully, do not remove wood where the edges of the lock-plate come, so as to leave open spaces for admission of water, dust or moisture. In letting in the locks the portions of wood to be removed can be ascertained by touching the prominent parts of the lock with oil, or holding the lock over a smoky lamp, so as to have soot adhere, then observe where it touches, on pressing the locks into place. Observe if the cup of the hammer comes squarely on the nipple, and put in the side bolts as they are to remain.

Letting in the Trigger-Plate.—Let the trigger-plate into the stock so that the arm of the sear bears wholly on the thick of the trigger, and not on the outer end. For this reason, if it engages the outer end, on being pulled to disengage the nose of the sear from the tumbler notch, it produces a sort of "twisted leverage" which does not work quick and strong enough to properly disengage the sear without some effort on account of this. If the arm of the sear bears only in part on the thick of the trigger, it works hard and stiff, and the parts soon wear each other. Observe if the arm of the sear be not too short, for it might happen that the trigger will slip off at the end upon a quick pressure being applied, leaving the parts disengaged and the hammer standing at full-cock.

Letting in the Trigger.—The trigger should be so disposed in the plate that a distance of an inch and about three-eighths exist between the right trigger and the front of the trigger guard, and an inch and three-sixteenths or more between the two triggers, and a sufficient space between the rear of the left trigger and the guard behind it to admit of free movement of the trigger. Observe if the triggers do not come too close to each other; if they do they may so rub upon each other that the action of one will compel the other to follow its motion, and the

result will be a descent of both hammers at the same time.

Observe if the curves of the two triggers are at sufficient distance from each other so that the left barrel can be fired without the projecting and inner edge of the right or first trigger hurting the finger that pulls the trigger.

Secure Fastenings.—For a secure fastening of the break-off, and, at the same time, to bind the stock together and prevent splitting through where the locks are let in, insert a screw through the tang of the strap and have it received in the front end of the trigger-plate. Have a good thread where the screw goes into the trigger-plate, and have the plate firmly drawn to its bed in the wood. Fit the guard, observing the measurements for space in front and rear of the triggers.

Fitting Bolt-Loops.—To ascertain the position of the loop where the bolt or wire goes through to hold the barrel in place, insert a fine steel needle through the wood until it strikes the hole, and then enlarge around it to accommodate the hole and the loop. If for a bolt, a slender tool made like a saw will enlarge the hole in the wood, letting the tool follow in the loop and act as a guide to shape the hole. The finishing of the hole in the wood may be done with a bolt float, shown in Fig. 24.

Hints for Finishing.—In finishing up the stock have the part where the cheek rests in firing made pretty full. Make it rather long than short, and

FIGURE 24.

have it more straight than curved. The length of a stock, be it double or single gun, from butt to front end of stock, may be from about two feet to two feet two inches; from the centre of the hammer-screw to front end of the stock, from ten to eleven inches.

Fitting the Break-off.—On good fitting of the break of depends, in a great measure, the lasting quality of the gun. If this be not properly fitted to the hooks of the breech, to the breech itself, and into the stock, the gun is soon "kicked" to pieces by its own recoil. The extension of the break-off that is let into the stock toward the breech is called tang, strap or tail, and these are of two lengths, called the long and the short. These lengths usually correspond with the lengths of breech pins. The smallest diameter of break-off is one inch, and increases by eighths of an inch up to two inches.

To let in Escutcheons, etc.—Do not fit in an escutcheon until that part of the stock is finished or made to form. Then, after the bolt is fitted to its place through the loop, remove the bolt, make the hole in the escutcheon so that the bolt slides easily through it. Hold the escutcheons on the stock in the place they are to occupy and put the bolt through them. Mark around them with the sharp point of a knife and remove them. Cut out the wood of a depth to correspond with the thickness of the escutcheon with a bottoming tool. Put them in place and fasten them. They can now be finished down with a file even with the stock.

It is well to have escutcheons with the ends long enough to admit of small screws being inserted to hold them. They are more permanent than those that are held by a wire-like extension that goes through the wood and is clinched a little. By using the screws the workman can make his own escutcheons. Sheet iron, brass or German silver may be used. The slot can be cut with a punch or drift, and finished with a thin, flat file. The handles of old German silver spoons make very good escutcheons. If too thick, hammer out thinner. Heat them to soften so that they will not crack in hammering.

In putting escutcheons to place where they are to remain, heat them quite warm, smear with gum shellac and, while soft and melted, press into place. If done expertly, a neat job will be the result.

How to Cast Tips on Fore-end of Stock.—Tips are cast on the fore-end of half-stocked single guns and rifles for the purpose of preventing the stock from splitting, and, at the same time, give it a finished appearance. After the stock is finished to shape and the rod fitted, put the barrel in place, and put a short piece of wood in the rod groove, the same as the rod would be if put there. Let the piece project from the wood four or five inches. It serves a double purpose, preventing the metal from flowing into the hole and making a hole to receive the rod. Now, wind thick, smooth paper—manilla paper is best—around the stock and barrel where the tip is to be cast, confining it with a cord, taking care to have all tight so that no portion of the metal will escape. See that the space between the paper and wood is left large enough, so that the metal can be dressed down a little; little notches may be cut in the wood to have it hold the better.

Fix the gun so as to stand upright, so that the metal will pour evenly. Heat the metal pretty hot and pour carefully into the paper, and pour in more than is wanted for the length of the tip, as the dross will float to the top and can be removed when cold by sawing off a little of the tip. File up and finish to suit the taste.

The best metal for tips is pure block tin, as it remains white. If it be wished to make it a little harder, add a very little antimony, but this is hardly necessary. Old type, when melted, make a very good material for tips when pure tin cannot be obtained. Tin has the advantage of always retaining a clear white color, which when alloyed with lead, it will not do.

Chequering.—To lay out the work preparatory for chequering, take a piece of card—a firm pasteboard, cut it to the shape of the spot to be chequered; mark around it with a lead pencil. If it be the small of a gun stock, place it at the other side from that first marked and mark that place. See that both places are marked alike. Then place the paper on, so that when it is used as a guide the tool will cut a groove where the line was drawn. Cut outlines in the same manner, the paper serving as a guide for the

tool. After one groove is cut, this is a guide for grooving the space inclosed by the outlines.

To finish the cuts or grooves, fold a short piece of fine sand-paper and run the folded edge along the cuts. Be careful not to cut down too much with the sand-paper. A fine-cut, three-square file can be used to finish up the grooves made by the chequering-tool. Be careful to select a file that has very sharp corners. If one of the flat surfaces of the file be ground smooth, the teeth on the corners will be found to be very sharp, and will answer first-rate for finishing. The same may be used for finishing the shading or outside lines around the chequered surface

Coloring Gun Stocks.—Gun stocks are colored with linseed oil in which alkanet root has been placed. The oil will then be of a bright red color. The oil may be applied cold or warm, as most convenient. After the application let the stock stand for a day or two until the wood has absorbed all the oil possible. Four ounces of the alkanet root to half a pint of the oil are sufficient. Unboiled or raw linseed oil is generally used. It may take five or six days to color, after the root is put in. It may be put on the work four or five times, with a bit of sponge or a rag.

To Stain a Maple Stock.—Mix an ounce and a half of nitric acid with about equal quantity of iron turnings or filings. Wait until all the gas evolved has evaporated, and then dip a rag in the liquid and wash the portions of the stock to be colored. When this is dry, wet with the oil and alkanet root.

Another Method.—A stock may be oiled and then passed over a brisk flame, as that made from dry shavings, until the oil is scorched off, and then lightly rubbed down with fine sand-paper and then finished in the usual way.

To Color a Maple Stock Brown.—Dissolve a few grains of sulphate of manganese in water; wet the stock and hold over the flame of an alcohol lamp so as to scorch it. By heating some parts more than others the color can be variegated. Oil with raw linseed oil, and polish with a piece of hard wood. The oil and polishing will develop the color, which may be dull at first.

To Color a Reddish Brown.—Brush the wood with dilute nitric acid, and when dry apply the following with a brush: Dragon's-blood, four ounces; common soda, one ounce; alcohol, three pints. Repeat if not dark enough.

To Color a Black.—Boil half a pound of logwood chips in two quarts of water; add one ounce of pearlash, and wash the work with it while hot. Then, when dry, go over the work with the following: Boil half a pound of logwood in two quarts of water; add half an ounce of verdigris and green copperas, in which has been put half a pound of rusty steel or iron filings.

Rosewood Stain.—Boil half a pint of logwood in three pints of water till the mixture is very dark red; add salts of tartar, one-half ounce, while boiling hot; and while still in this condition apply to the wood, repeating the application two or three times, as the previous application becomes dry. Rub over with a soft cloth when the last application has dried, and set away for a day or so. In the meantime boil one pound of logwood in four quarts of water until of a deep color, then add one pint of vinegar, heat hot and apply to the wood already stained, with a suitable brush, streaking on in imitation of rosewood. When thoroughly dry rub off all loose matter with a soft cloth, and varnish.

Black-Walnut Stain.—Put together gum asphaltum, one pound, and turpentine, half a gallon. Dissolve by gentle heating, taking care not to heat so as to ignite the turpentine. Rub over the wood, and when dry, if not sufficiently dark, repeat the operation. Having the shade to suit, polish down by rubbing hard with a woollen cloth, followed with a bit of soft wood, then varnish. A stain, not quite so good, but cheaper and more simple, is burnt umber, such as can be bought at any paint shop, ground in oil, thinned with a little turpentine. It should be put on very thick, and then rubbed off to the proper shade with a woollen cloth. Dry and varnish.

Mahogany Stain.—It is not often that guns are stocked in mahogany, but the gunsmith ought to know how to stain in imitation of that wood, should occasion happen to call for it. Put together, water, one half gallon; madder, four ounces; and fustic, two ounces. Boil. Lay on the wood with a brush while hot; and while yet damp, but not wet, rub off with a woollen cloth; then, when dry, go over with a second coat in streaks to imitate the grain of mahogany. Rub off all loose matter when dry, and varnish.

Cherry Stain.—Put two ounces of annatto in half a gallon of rain water. Boil until the annatto is dissolved, then add half an ounce of potash This preparation is intended for wood of a light color. It may be bottled and kept for use when wanted Nothing to do in the application but rub over the wood, let dry, and then varnish

Oil Finish for Gun Stocks.—Mix common Spanish whiting with some kind of coloring material until it is exactly the shade of the wood you desire to finish. For instance, if it is walnut to be finished the coloring agent will be dry burnt umber. Having the whiting ready, give the wood, which has been well finished up with fine sand paper, a coat of raw linseed oil, then sprinkle the whiting mixture over it, and with a woollen cloth rub thoroughly and hard. This forces the colored whiting into all the pores of the wood. Lastly, rub down heavily with a piece of soft white pine, and then set away to dry. It may be left in this condition, or it may be varnished, when dry, if thought desirable.

Varnishing and Finishing.—After the stock is shaped and sand-papered so that the surface is smooth and free from any marks of the rasp and scratches of sand-paper wipe it over with a cloth a little moist with water, this will raise the grain of the wood a

little, when dry, sand-paper it off smooth. With a small brush, such as is used by painters and called a sash brush, apply the varnish. Shellac varnish is the kind generally used by gunsmiths. It will dry in a little time, but ought to stand about twenty-four hours before being rubbed down. This is done with fine sand-paper the same as finishing the stock, the object being to fill the pores of the wood as much as possible. It may require two, three or even four coats of the varnish to do this, each one after it is thoroughly dried, being sand-papered down to the wood.

The last coat of varnish is laid on with a flat varnish brush made of soft fine hair; see that the varnish be free from dirt or specks and not too thick; put it on evenly and quickly. See that it does not run down so as to show in streaks. When this coat is thoroughly dry, rub it down smooth with powdered pumice stone applied with a rag wet with water. Take care not to cut through the varnish so as to show the wood underneath, as the pumice powder cuts very fast. When the surface is made smooth and even, wash off all traces of the pumice powder with a wet cloth, and wipe it dry. Now go over it with powdered rotten-stone applied with a rag moistened with oil. Rub until the varnished surface shows a finish or a glassy appearance, then wipe off all trace of rotten stone and oil. If a little flour be dusted over, it will better remove the oil traces that may remain; with the hand rub the surface until it presents a gloss. The hand must be soft to do this and must be free from dirt.

FIGURE 25.

The Varnish for Gun Stocks.—Some workmen use copal varnish because it is cheap and convenient, but it is objectionable on account of its softness and its disposition to crack when exposed to the sun. There are a number of special varnishes recommended to the gunsmith, but for general use perhaps good coach varnish, will answer in many cases. It should be made quite thin with turpentine, and be put on lightly.

Varnish Can.—A very good form of varnish can is shown in Fig. 25. The essentials are to have a cover with a stem to receive the handles of the brushes, and a bridge crossing the can a little distance down from the top. The cover never sticks, no varnish collects around the sides, and it is always clean and tidy. The can is round and made of tin. The cover shuts over the outside at the top. In wiping the brush across the bridge, be careful not to get any upon the outside of the can where the cover comes in contact. The size of can may be made according to the needs of the mechanic, but the stem of the cover must be wide enough as well as long enough to receive the brush handles.

CHAPTER XV.

On Gun Barrels
Long and Short Barrels
Proof of Barrels
Proof Marks on Barrels
Gauge of Guns
Bursting of Barrels
To Prevent Barrels from Rusting
Protection from Rust

CHAPTER XV.

ON GUN BARRELS.

Long and Short Barrels.—A long barrel may be preferable for several reasons: 1st. A longer distance between the sights is given and the back sight can be put farther from the eye, so that finer sighting is possible; 2d. A long barrel is steadier in off-hand shooting; 3d. It permits a slower burning powder to be used, so that the charge starts more slowly and yet allows the full strength of the powder to be used before it leaves the barrel, getting a high initial velocity with but little recoil.

The short barrel has an advantage over the long one inasmuch as it can be handled with greater quickness and the sight can be brought to bear more readily, especially if the game be moving. If the barrel be long enough to give the charge the full benefit of the propelling power of the powder it may be deemed all sufficient. Yet, as to this, tastes and experience may so differ as to raise many conflicting opinions.

Except in some localities, as in case of districts where the old-fashioned Kentucky rifle is used, long barrels have been pretty much abandoned. A few years ago it was not uncommon to find barrels three and even four feet long, now the lengths will range from twenty-six to thirty-two inches. The length of the old Government musket barrel was originally forty inches, but has been lessened about seven inches. With the long barrels, a coarse, slower burning powder may be used and get a good result, but as a general thing cut off the barrel to a convenient length for off hand shooting and moving game, use a finer-grained powder, which will be quicker burning and just as good results are ob-

A gun having barrels over thirty inches in length, must needs be made with heavy barrels, and is very fatiguing to carry in an all day hunt. A gun of this kind, to be safe and well-proportioned, ought to weigh nine or ten pounds.

If fine and quick burning powder be used in a long barrel, the powder is flashed into propelling gas, instantaneously, and beyond a certain length of barrel has no further expansive power, and the result is a friction of the charge in escaping, that affects the shot and consequently the pattern on the target. If

slow burning powder be employed in a short barrel, the whole of the powder cannot be so instantly flashed into the propelling gas and some portion of it is, as a result, driven unconsumed from the muzzle of the gun.

This fact can be very readily ascertained by firing a gun over a bed of clean snow or over a spread of white cloth. The unconsumed grains can be readily seen on the white ground. If a less charge be used in order to consume all the powder, less velocity will be given to the projected charge, and weak shooting and a poor, scattering effect on the target is the consequence.

Proof of Barrels.—In consequence of the bursting of guns of an inferior quality, all barrels of English manufacture that are intended for home use, and also those designed for exportation, except a certain class of arms, are required by law to be proved and stamped with the proof-mark and also what is termed a view mark, which is a stamp or impress of the inspection after the barrels were grooved. There are two of these proofs called, respectively, the London and the Birmingham proof. In 1855, an Act was passed by the English Parliament, called, "The Gun Barrel Proof Act," which enacted that all barrels should be proved, first, in the rough, and was called the provisional proof, and afterward when the barrels were put together, breeched and percussioned they were proved again, and this was called the definitive proof.

The arms to be proved are to be divided into classes, and the first class comprises single-barrelled military arms of smooth bore, and they are not qualified for proof until they are fitted and complete to be set up or assembled. The second class comprises double-barrelled military arms of smooth bore and rifled arms of every description, whether of one or more barrels, and constructed of plain or twisted iron. The fourth class comprises double-barrelled guns for firing small shot, and these are subject to the two proofs, provisional and definitive. For provisional proof, if of plain metal, the barrels are to be bored and ground to size, the vent hole drilled of a size not exceeding one-sixteenth of an inch diameter, and a vent enlarged to one-tenth disqualified it for proof. Notches in the plugs, instead of drilled vents, also disqualified them. If the arms are of twisted metal, they are to be fine bored and struck up, with proving plugs attached, and vents drilled the same as in plain barrels.

For definitive proof the barrels, either plain or twisted, must be finished ready for assembling, with break-offs and locks fitted. The top and bottom ribs have to be rough struck up, pipes, loops and stoppers on, and the proper breeches in. The same finished condition is required for rifles, but, in addition, the barrels must be rifled. The third class comprises single-barrelled shot guns, and for proving they are to be finished ready for assembling, with breeches in; and all barrels, with lumps for percussioning, are to be proved through the nipple hole. The fifth class comprises revolving and breech-loading arms of every description and system, and for revolving arms are to have the cylinders with the revolving action attached and complete. The barrels for breech-loaders are subject to provisional proof, according to the class to which they belong, and to definitive proof, when the breech-loading action is attached and complete.

Barrels made by the United States Government, or barrels made for the Government, are subject to severe proofs. At the armory at Springfield, the barrels submitted for proof are loaded, first, with a 500-grain slug and 180 grains of powder, and afterward with a slug of the same weight and 250 grains of powder. An inspection of the barrel is made after each firing, and other inspections after rifling, browning, etc.

Probably the most severe proof of barrels was made with the Turkish Peabody-Martini rifles as made for the Turkish Government by the Providence Tool Co. The barrels were first proved for strength, and were loaded with 205 grains of powder and 715 grains of lead. The regular cartridge for service contains only 85 grains of powder and 480 grains of lead.

Proof Marks on Gun Barrels.—The marks applicable to the definitive proof are the proof and view

marks of the two English companies, viz.: the London and the Birmingham. The provisional proof marks consist of, for the London company, the letters G. P., interlaced in a cypher surmounted by a lion rampant, and for the Birmingham company the letters B. P., interlaced in a cypher surmounted by a crown. The London marks are shown in Fig. 26, and the Birmingham in Fig. 27.

The method of affixing the proof marks in arms of the first and third classes, the definitive proof mark and view mark is impressed at the breech end of the barrel, and, if the barrel be designed for a patent breech, the view mark is also impressed upon the breech. In arms of the second, fourth and fifth classes, the proof mark is impressed at the breech end of the barrel; the definitive proof and view marks are impressed upon the barrel above the provisional proof marks. If the barrel be made

FIGURE 27.

with patent breech or with revolving cylinders or chambers, the view mark is impressed upon the breech or upon the cylinders or chambers, as the case may be.

On all barrels the gauge size of the barrel is struck both at the provisional and at the definitive proof These gauge marks are readily recognized, as shown in the cuts of the proof marks.

Barrels stamped with London marks are not always made in London, for some gunmakers send their barrels to London to be proved, because guns so marked find a readier sale. Barrels with foreign proof marks are exempted, except in case of being marked as of English manufacture. Old muzzle-loaders, if of English manufacture, intended for conversion into other styles of guns, must be subjected to both provisional and definitive proof.

It is said to be a fact that the proof marks of both companies are forged and imitated, both in England and in Germany, and many cheap guns so stamped are exported to this country. A cheap gun, with the stamps mentioned, may be looked upon with suspicion as to its really having been in the official proof-houses.

The proof marks employed by the inspectors in the U. S. Government armories, and placed on all arms inspected by them, even if made in private armories, are V for viewed, and P for proved, together with the initial letters of the inspector's name, and are found stamped on each barrel. On many guns of the old model arms will be found, in addition to these marks, the head of an eagle. This is the mark that indicated that the barrels were made at the armory at Harper's Ferry, when those works were in operation.

Gauge of Gun Barrels.—Guns are gauged by numbers, and these numbers were originally designed to express the number of round balls to the pound that would fit the bore of the barrel. Thus a ten gauge, a ball of which ten made a pound, would fit the bore, etc. Ten and twelve bores are generally used by sportsmen, especially those who use breech-loaders. The twelve, perhaps, is the one most employed.

The following list shows the sizes of various gauges, the values of the numbers being those adopted by the English proof companies. The diameters of bores being expressed in decimal thousands of an inch :

Number of Gauge.	Diameter of bore in inches.	Number of Gauge.	Diameter of bore in inches.
1	1.669	19	.626
2	1.525	20	.615
3	1.157	21	.605
4	1 052	22	.596
5	.976	23	.587
6	919	24	.579
7	.873	25	.571
8	.835	26	.563
9	803	27	556
10	.775	28	550
11	.751	29	.543
12	.729	30	.537
13	710	31	.531
14	.693	32	.526
15	.677	33	.520
16	662	34	.515
17	.650	35	.510
18	.637	36	.506

Muzzle-loaders are of almost every variety of gauge, while breech-loaders are made of a limited number of sizes. The sizes of this class of guns are 8, 10, 12, 14, 16 and 20, and are limited to these sizes, there being no intermediate sizes. The 10 and 12 bore are mostly in use, the 12 being in especial demand. The calibre or bore of military guns during the Revolution was 75 hundredths of an inch, and has been reduced by successive stages until now it is but 45 hundredths. Down to 1856 the calibre of the Springfield musket was 58 hundredths. In 1856 it was changed to 50 hundredths or one-half inch; and again, in 1873, it was changed to the present calibre of 45 hundredths.

Bursting of Barrels.—Bursting of barrels may result from three causes: Poor quality of iron of which the gun is made; an excess of charge; or some obstruction in the barrel so as to form an air space between the charge and the obstruction. Of poor quality barrels, and excess of charge it is needless to make mention. The instances of bursting from obstructions forming the air space or chamber may be mentioned in military guns, firing the charge but neglecting to remove the wooden tompion from the muzzle of the gun. In sporting guns snow may accidentally get into the muzzle or a lump of dirt may "somehow" get in so as to fill the bore, and when the gun is fired, it will probably, yes, most certainly be blown off or blown open where the obstruction exists; the muzzle of a gun being thrust into water for a couple of inches or more will have like effect. The gas formed by burning the powder finds no outlet of escape, and the whole expansive force concentrates itself on the weakest portion of the barrel, and as a result it is forced apart. In good guns the portion toward the muzzle is the thinnest, and obstructions are generally at or above this place, and it is in this proximity where most guns are burst. If within three, four or five inches from the muzzle, the portion so destroyed can be sawed off, the barrels squared up and it will not always seriously affect the shooting of the gun.

In loading a gun be careful that there be no air space left between the charge and the ball or shot cartridge. In double guns, frequent firing the right barrel, which is the one fired the most, the recoil will often cause the ball or shot charge in the left barrel to be thrown forward from the powder, and when it is fired may either strain or burst the barrel. Even if there be a small air space between the powder and the ball or shot cartridge it will affect the shooting. Every one using double guns should accustom himself to the use alternately of both barrels, not only for safety but for good shooting. A barrel is often said to be a poor shooter, when its bad qualities may be wholly ascribed to the air space produced above the powder by the recoil occasioned by firing the other barrel.

To Prevent Gun Barrels from Rusting.—Heat the barrel to about the temperature of boiling water, no higher, and then cover it with a good coating of copal varnish. Let it stand at same temperature about half an hour, then rub off the varnish while still hot with a soft cloth. In this process the varnish will enter the pores of the metal sufficiently to prevent rusting, but will not show on the surface

after having been carefully rubbed off as directed. A polished surface like that of a finished gun barrel, is not much liable to rust, and, indeed, seldom begins to rust, the rust starting in the pores of the metal and finally working outward. This being the case it will readily be seen that sheltering the pores by filling them with some kind of substance impervious to moisture cannot do otherwise than act as a splendid preventive.

Protection from Rust.—It sometimes happens that finished up articles in steel or iron must be laid away for a considerable length of time, in which case it is desirable to employ some means for protecting them from the effects of rust. One of the most common things is to either grease them or wrap them in a greasy rag. This may answer in many cases, but it is not nearly so good as to paint them over with a mixture of white lead and tallow in equal parts, the white lead to be such as has been ground in oil for the painter's use. In this simple mixture will be found an effectual protection; and as the tallow will prevent drying, it may be entirely removed at pleasure by rubbing with a little kerosene or turpentine.

Where it is desirable to protect an article that must be handled a great deal, as gun-barrels on sale in a store, for instance, a very good plan is to heat the article sufficiently hot to readily melt beeswax brought in contact with it, then rub it thoroughly with the wax. Let it stand until the wax is about ready to harden, then rub off with a coarse woolen cloth. The wax remaining on the metal will not show, but there will be enough left to protect it from rust.

CHAPTER XVI.

On Work on Gun Barrels.
Boring Gun Barrels.
How to Make Cutters for Boring
Quick Boring Gun Barrels
Proving the Size During Boring.
Draw Boring
Choke Boring
Choke Dressing
Barrels Most Suitable for Choke Boring
Freeing Gun Barrels
Another Method
Finishing Muzzles of Gun Barrels
Old Method of Straightening Barrels
The New Method
Another Method
Fitting Barrels Together
Jointing Barrels Together
Soldering Barrels Together
Why Not Braze Barrels
Percussioning
Finishing Nipple Seat
The Vent in Percussion Guns
The Patent Breech
Form of the Chamber or Cup.

CHAPTER XVI.

ON WORK ON GUN BARRELS.

Boring Gun Barrels.—The tool used for this purpose consists of a rod a little longer than the barrel to be bored, with a cutter head at one end. This cutter is about one-half or three-quarters of an inch long, and of a diameter a little larger than the bore that is to be enlarged. It can be made to be pulled through the barrel or to be pushed through when cutting. In the armories where many guns of the same calibre are made, a portion of the shank, next to the cutter, is made of the bore of the barrel, and the cutter made of the size the bore is to be enlarged. The portion that fills the bore acts as a guide, so that the cutter is forced to follow after it, and the enlarged bore is in the same line as the boring previously made. The cutting edges of the tool are, of course, next to the enlarged portion. As the tool is pulled through the barrel, the cuttings are left behind it as it advances; oil is to be supplied while cutting, and care must be exercised not to let it get clogged with cuttings, as a tearing of the surface of the barrel would be the result.

When the tool is made to be pushed through while cutting, the cutting edges of the tool is on the end, and it operates like a reamer. This cutting end should be bevelled off so as to follow the bore to be enlarged.

How to make Cutters for Boring.—One way to make these cutters is like a many-fluted reamer, with five, seven, or more cutters. The odd numbers will operate better than even ones. If made with too many cutting edges, there will not be clearance enough for the chips, and clogging will be the result. Then again, the cutters must not be too long, or there will be too much friction, and the barrel will become very hot in working. Also, if the friction is too great, the barrel may be bent and sprung in consequence.

One form of cutter is made like the cherry to make an elongated bullet, or like the cherry of a Minie bullet. They may also be made in form of an egg. A common twist drill welded to a steel rod has been used for small bores. A small fluted reamer welded to a rod will do where the enlarging is quite small. When the tool is to be pulled through the cutter may be made like a short twist drill not over an inch long, with the cutting edges next the rod, and not on the end, as these drills are generally made.

Quick-Boring Gun Barrels.—The way to bore gun barrels by hand is this: Make a steel rod with a square bit about six or eight inches long on one end, and a little less in diagonal diameter than the bore of the barrel. The whole rod should be a little longer, say a foot or so, than the barrel to be bored. Harden and temper the bit end. See that it is true and perfectly straight when ground. The grinding should be done by drawing the bit across the face of the grindstone, and thus will leave the sides of the bit a little hollowing, and the edges quite sharp. Pack up one side with a thin strip of soft pine until it will just enter the breech end of the barrel. By means of a strong bit stock, or a handle affixed like an auger, turn it around, at the same time forcing it toward the muzzle, until it has cut its way through the entire length of the barrel. While the cutting is going on keep the interior of the barrel plentifully supplied with good oil. Now, as the bit will be a very little smaller than the bore of the barrel, remove it and take off the little strip of wood and

place between it and the bit a strip of writing paper of the length and width of the side of the bit where the wood was placed; then insert the bit again at the breech and bore through to the muzzle. Repeat the operation again by inserting a second slip of paper, and so proceed, using plenty of oil, until the bore or calibre of the barrel is sufficiently enlarged.

Proving the Size during Boring.—A method of proving the size of the interior of the barrel and at the same time test its being perfectly of the same size throughout, is to cast an ingot of lead about an inch long in the muzzle, and with a rod forcing it through.

If the work be well done the interior of the barrel will present a bright mirror like appearance, and will need no further finishing.

Draw-Boring.—Draw-boring is done with a rod that nearly fills the bore of the gun, and at one end of this rod is fitted a tool made like a short piece of file, but with the teeth made a great deal coarser and larger. This tool may be about an inch long, and of a round form on the cutting side, to fit the curvature of the bore. This tool is put on the end of the rod and worked back and forth, also turning it around, so as to present the cutter to all sides of the bore in which it is to operate. When it will cut no more the cutter is removed from its seat, a slip of paper put under it, and it is put in place and the operation repeated, and so continued until the bore of the gun is sufficiently enlarged.

Pieces of thin files, broken to length and with the ends ground to fit the rod have been used for draw-boring, but the best and most effective tool is a bit of steel filed up to shape and properly fitted. One half of the cutting teeth should point forward and the other half backward, so that the cutter will remove some of the metal as it works in either direction, forward or back. If the cutter be an inch long, about three or four teeth may point one way, and as many the reverse direction.

In using these tools, keep them well oiled, to prevent tearing into the metal.

Choke-Boring.—The method of making a choke-bore is similar to quick boring, except the cutting end of the rod does not go quite through the barrel, being withdrawn and again inserted with a slip of paper placed between the slip of wood and the cutter. This is worked not quite so far as the previous boring, being withdrawn and another slip of paper placed between the wood and the cutter, and this is worked in as far as desired. Care must be taken that the choke be gradual and even. A finish can be given by folding a piece of fine emery cloth or emery paper around a rod, and by turning this in the barrel, equalize any unevenness that may occur.

To enlarge the interior of a barrel, boring it choked at both breech and muzzle, push the rod to the distance from the breech the enlarging is to commence, and then commence boring, leaving off where the muzzle choke is to commence.

If the bore of a barrel is made to taper from muzzle to breech, it will scatter. If made to taper too much from breech to muzzle, it will compress the shot, and by so doing mangle or deface them so that they will "shoot wild," while at the same time the effect on the gun will be to spring the barrel, and, if it be thin at the muzzle, as generally made, there is danger of enlargement of the bore at this portion of it.

Choke-Dressing a Gun Barrel.—A very slight variation in the size of the bore of a gun-barrel at one of its ends often has a marked effection its shooting. In case where a shotgun is disposed to "scatter" too much, the remedy lies in enlarging the bore at the breech. Choke-boring would be the means resorted to where such an operation was convenient; but where not, choke dressing may be made to answer a very good purpose. This consists in dressing out the breech with fine emery paper or cloth, wrapped upon a round wooden rod. A little oil should be used in finishing the dressing, which need not extend above half the length from the breech to the muzzle. No particular attention need be given as to the slope, as the size of the bore, under this operation, is sure to be left largest at the breech.

Barrels most Suitable for Choke-Boring.—Laminated steel barrels are the most suitable for choke-bore guns, being harder and more tenacious than Damascus, and, therefore, resist the repeated strain of heavy charges better; they will be found to be more durable, and lead less than barrels of softer material. Barrels of plain steel, or decarbonized steel, so called, should never be used for choke-bore guns, as they are unsafe for guns with light muzzles. Decarbonized steel is most suitable for rifles, where great strength of metal is employed. The finest pattern in Damascus is not always desirable, as the excessive twisting necessary to make the fine pattern often weakens the fibre of the metal.

Freeing Gun Barrels.—It is often desired to free a barrel at the muzzle, or at both breech and muzzle; and the amount to be removed is so very little that it is hazardous to insert the boring bit for fear of removing too much. It is easily accomplished in this manner: Select a straight wood rod that does not quite fill the bore of the gun and saw a slit with a fine saw at one end, for about three or four inches, and parallel with the length of the rod. Cut strips of fine emery paper, or emery cloth, the width of which should be the same as the length of the slot, insert one end in the slot and wrap the projecting part around the rod, introduce this end into the barrel and work it up and down, if it be desired to finish the barrel that way, or turn it around by means of a bit stock or lathe if the finish is to be thus done.

Many gunsmiths cast soft lead at the end of a rod, using the muzzle of the gun as a size mould, and after removing from the barrel, apply oil and fine emery, and with this work the inside of the barrel.

Another Method.—There is another plan. Make a rod of soft pine wood that almost fills the bore and make a small hole, say about one-eighth of an inch diameter at the point where the saw kerf is to termi-

FIGURE 28.

nate. Cover this portion of the rod with good glue, made thin, and then roll it in the emery, the same as making an emery wheel or a buff-stick. When dry use it in the same way as the other forms of rod. When desired to increase the size, which will be necessary, a thin wedge can be inserted in the saw-kerf and pressed deeper in as the bore increases, or near as the rod diminishes its size. By wrapping the rod with fine twine where the hole is made there will be no danger of splitting the rod when the wedge is pushed in. The same form of wedge can be used in the rod first described, and at the same time the wedge will help keep the emery cloth or paper in place. The cut, Fig. 28, shows the rod as ready to receive the coating of emery.

Finishing Muzzles of Gun-Barrels.—To shorten a barrel, the general custom is to cut it off with a three-square file, by filing a groove around it, or else saw it off with a hack-saw; the latter method being preferable, as by sawing completely through the barrel the piece is removed with no temptation to sever it by bending, as is often the case when cutting off with a file.

After the piece is removed use a tool like the one shown in Fig. 29, to square up the end. This tool

FIGURE 29.

has a cutting part an inch in diameter and about an inch long. It is turned smaller back of the cutting portion, to make it lighter or better to handle. A hole, three-eighths of an inch diameter, is made centrally in the cutting end, and in this hole are inserted iron or brass plugs made to fit, and the other end of a size to fit the bore of different guns. After the barrel is squared up, bevel the inner edge of the muzzle with the tool, Fig. 30, which is nothing more than a common "rose-head," and is made with similarly formed cutting teeth. About sixteen teeth are sufficient for these tools. The rose head tool has the cutting end about an inch diameter and nearly the same length, one-half the length being taken up by the pointed cutting end.

Old Method of Straightening Barrels.—The old-time method of straightening a gun-barrel was by means of a fine thread of black silk or a hair, which was passed through the bore of the barrel. This line was drawn tight by being stretched from two

FIGURE 30.

ends of a rod of wood or spring steel, the elasticity of which kept it taut, and the workman looking through turned the barrel round so as to bring the thread of hair into coincidence successively with every portion of the inner surface. If there existed any concavity in any part of this surface, the thread would show it by the distance which would there appear between the thread itself and its reflection in the metal.

The New Method.—There is another process of straightening barrels which was explained by a writer in a scientific paper a few years ago, which is termed "straightening by the shade," and by this method barrels can be straightened with a greater degree of precision than by any other known process. The principle is something like this: If we examine a plane mirror for the purpose of ascertaining whether its reflecting surface is a true plane, we cause objects to be reflected from it to the eye at small angles of incidence. If under these circumstances every part of the mirror gives an image true to nature, he pronounces it perfect; for the slightest deviation from a true plane would cause a manifest distortion of the image. In the process of straightening barrels by the shade, crooks in the bore are detected upon the same principle. The internal surface of the barrel is a mirror, and whatever objects are reflected to the eye from any portion of it that lies beyond a certain distance, will be reflected under very small angles of incidence. As the interior surface of the barrel is not a plane mirror, the reflected image will not be true to nature. If the bore be straight, the image will have a normal distortion, which is due to the transverse or cylindrical curvature of the mirror; while if there be longitudinal flexures or crooks, there will be an abnormal distortion of the image, which will reveal the defect.

When the eye looks into a gun barrel the interior surface appears to be spread out into a plane circular disk, as far from the eye as the other end of the barrel. Through the centre of this disk is a circular orifice, and surrounding this at equal distances from it and from each other, respectively, are several well defined concentric circles, dividing the disk into as many bright concentric rings, each of an apparent breadth, precisely equal to the diameter of the central orifice which is the other end of the bore as seen by direct vision. The several concentric circles are so many images of the end of the bore reflected to the eye from different points along its length. The first of these circles, or that nearest the central orifice, is an image formed by light once reflected. The second, third, fourth, etc., respectively, are images formed by light reflected two, three, four, times, etc. In order to see how these images are formed, and to find their respective points of location in the bore, consider that a ray of light from each point in the end of the calibre, as shown at *a*, Fig. 31, may pass to same point *b*, on the other side of the bore, and be thence reflected to the eye, thus forming at *b*, an image at the end of the bore, of one reflection. Another ray from the same point may pursue the route *a*, *c*, *d*, *e*, forming an image at *d* of two reflec-

FIGURE 31.

tions. Another ray may take the route, *a*, *f*, *g*, *h*, *e*, forming an image at *h* by three reflections, and so on for the other images since in the formation of each of these images, respectively, the angles of incidence and reflection are equal, it follows that the focus, or point of place of the image *h*, formed by one reflection of light, is at one-third of the distance from the eye to the further end of the bore; that formed by two reflections *d*, is one-fifth; that by three reflections is one-seventh, and the succeeding ones, one-ninth, one-eleventh, etc., of the same distance

Therefore, it will be observed that all these images are located within the third part of the length of the bore nearest to the eye. Consequently there are two-thirds of the entire length of the bore in which none of these images appear. It is to this part of the bore, only that the workman directs his attention, for it is here only that he can cause the "shade" to appear which discloses the crooks in the bore if any exist. When this part is straightened, he inverts the barrel and works from the other end.

The practical application of the process is made in this manner: the workman has a rest, generally consisting of an upright strip of board of convenient height with a V cut in its upper end for convenience in resting the barrel in case of rotating it. Across a window opposite, at almost any distance, say about ten or twelve feet, is nailed horizontally, a strip of board like a common lath, as the horizontal bar of the window sashes where they come together at the middle of the window (provided there be upper and lower sashes) will answer nearly as good a purpose Now place one end of the barrel in the V of the rest, look into the bore, directing the eye to the lower side of it and to the point just beyond the image *b*; gradually depress the end held in the hand, bringing the direction nearer and nearer to the horizontal strip, or the sash bar as the case may be, and a dark shade is soon seen as shown at *n*, Fig. 32. This is the reflected image of the horizontal strip, or sash bar, the curved part of the outline being the image of the straight-edge. Depress the end more and more and the shade lengthens to *n*, *o*, *p*, etc. If the bore be perfectly straight, the shade will always maintain a true and symmetrical parabolic form, growing more and more pointed at its apex, until it reaches the further end of the bore. But if there be even the slightest flexure or crook in the bore the parabolic figure of the shade will be distorted. If a distortion be discovered, the barrel is slowly revolved about its axis as it is retained in the rest; at the same time slightly elevating and depressing the end held in the hands, until the shade assumes a form in which the two sides near the apex are equally drawn in toward each other as shown at *q*. If the crook be considerable the two sides may be drawn quite together, cutting off a portion of the shade of the apex as at *r*

FIGURE 32.

This tells that there is a crook at *q*, and also tells that the bore is concave downward at that point. It will require some experience to tell how far that point is from the eye, but when that is learned, the fore finger placed upon this point on the under side of the barrel tells where the blow must be given to straighten it as it ought to be.

Another Method.—Another method to ascertain if a barrel be straight, is to insert a slip of card into the muzzle of the gun and then look through the bore to the light. If the slip of card be properly placed the "shade" can readily be seen. The card slip need not be more than one-quarter of an inch in width and in length to just fit the muzzle so that it will be retained in place. It must be placed with the edge of the card toward the eye

Fitting Barrels Together.— When selecting a pair of gun barrels, preparatory to joining them for the purpose of making a double-barreled gun, it is necessary to ascertain if the barrels be of the same length, and have the same size at breech and muzzle, and also at points between the breech and muzzle. Nearly all shot-gun barrels are ground, or made some smaller at the centre of their length than at other portions. Any one who is not conversant with this may be somewhat surprised on placing a straight-edge along the side of a barrel, a common musket barrel, for instance. Place the straight-edge on the top or bottom side, as the right and left hand sides are flattened, near the breech, and, of course, on these sides the hollowing of the centre is not so readily observed

As the musket barrel has been mentioned, it may be inferred that two of these barrels are to be joined together. The first step is to cut them off at either end, to make them of the length desired, for as issued from the armories for army use, the barrels are too long to make a gun to be handled with ease and convenience. If they are cut down to the length of thirty or thirty two inches they will be long enough for sporting purposes. According to the weight of gun desired, cut from either end; cut off the breech if a light gun is wanted, or cut off the muzzle to make a heavy gun

The first step after cutting off and truing up the ends of the barrels, is to select the two sides to be joined together and file these two sides flat, more at the breech and less at the muzzle, until the smaller diameters at the middle just touch each other, without being so filed

When you have in the way both barrels flattened as nearly alike as possible and as straight as can be done by testing with a straight-edge, lay both barrels on a level surface, and see that the flattened places touch each other true and evenly. To know if the flattening has been done parallel with the outside flats at the breech (supposing these to be left on the barrels) place a small square on the same surface on which the barrels are laid, letting the upright arm of the square just touch the outside flat. If the square touch the flat alike from top to bottom, then the flats are parallel, but if there be an open space to be seen, then file away the flat to be joined until the square indicates that both inner and outer flats are parallel. Be particular in regard to this, as it is

easier to correct the inner flattened surface than to make parallel the outer one.

If the same amount be taken from the breech as from the muzzle, the point of divergence will not be sufficient for accurate shooting. More must be taken from the breech to allow of this divergence to be extended a greater distance. The flattening at the muzzle does not require to be very great, yet must be done to some extent; but, as before remarked, this will depend upon the smallness or size of the middle portions of the barrel.

It is very doubtful if any two gunsmiths will agree as to the inclination of a pair of barrels. Perhaps it would be almost foolishness to insist on any definite or certain inclination, so that the converging lines would come to a point. As an instance, let the point of divergence be two and a half yards, it follows that at forty yards the right barrel, if the gun were rigidly held as if fixed in a vice, would throw its charge about six inches to the left of the mark, and the left barrel, vice versa.

Let it be supposed that two barrels are each thirty-two inches in length and one-sixteenth inch thick at the muzzle and three-sixteenths thick at the breech, it requires the difference four-sixteenths be multiplied by the times the length of the barrels are contained in the forty yards, thus being forty-five, to ascertain what distance the point of the different lines are from each other. In this case it is eleven and one-quarter inches, or five inches and five-eighths of an inch from the centre or line of sight. It may be remarked that if the point of convergence be forty yards it will be productive of as good results, perhaps, as any other.

Joining Barrels Together.—After the barrels are fitted together so that they are parallel, touching each other their entire length and equally in a vertical line, the next thing in order is to fit the top and bottom ribs. Fit the lower thimble or pipe through which the cross-bolt goes and cut the under rib to fit both above and below it, as this thimble is soldered direct to the barrels, not to the rib. Mark along the sides of the ribs with a sharp scriber, so as to leave a distinct line on the barrels to indicate their location. File bright and smooth the parts of the pipe and ribs where they are to be joined to the barrels and tin with good soft solder. Also tin the barrels where they are to be joined, and where the ribs come in contact. This is easily done by using a clear charcoal fire and heating the barrels and ribs quite slowly. Use muriate of zinc for flux, and apply the solder with a common soldering copper. If the copper be quite heavy and well heated the ribs can be tinned from the heat of the copper, as there is no need of putting these parts in the fire. If the barrels be properly heated and the solder beaten out thin on an anvil, it may be rubbed on the barrels without the aid of the copper. When it melts and flows, wipe off the surplus with a woolen rag which has been slightly moistened with oil.

When the barrels and other parts are nicely tinned, let them cool, and then fasten them in place in the manner they are to remain with binding-wire. Put a rod of iron through the lower thimble, and also through the upper thimbles, if they are to be fastened at this time. The reason of putting in this rod is twofold: it serves to keep the thimbles straight with the barrels, so as to properly receive the ramrod, and at the same time tends to hold the under rib firmly in place.

Before fastening the parts with binding wire, fill the space between the top rib and barrels with small pieces of solder, or what is better, a small rod of solder like a wire, but not large enough to interfere with the rib fitting close to the barrels.

Soldering Barrels Together.—Now begin to carefully heat the work, commencing at the breech, and when sufficiently hot, don't heat too fast nor too hot, apply solder, using the muriate of zinc as a flux, to the joinings of the ribs and barrels. If the solder be hammered quite thin it will be readily melted by the heat of the barrels, and will be "sucked in" until the space between the different pieces is completely filled. Proceed carefully in this way until the entire length of the barrels is gone over. Turn the work often in the fire, so that all portions are evenly heated. At the muzzle fit and insert a small piece to fill the interstice between the barrels and the top rib.

It is necessary that all the space between the top rib and the barrels be completely filled with solder, or rust will form there, which will prove of serious detriment to the barrels, and in time work under the ribs, throwing them from the barrels if even a little torsion or springing of the barrels should ever take place.

During the progress of soldering, see that the parts are kept pressed close together, and that they do not spring away from each other by their expansion during heating. A small iron clamp screw placed at the breech and also one at the muzzle, is very convenient, as by tightening the screw there is less danger of the parts springing apart. When the breech is soldered and somewhat cooled, the clamp there placed can be removed. These clamps, made of malleable iron, can be obtained at the hardware stores.

When the work is soldered and is cool, wash it well with warm water, using a stiff brush to remove dirt and all traces of the acid flux that may remain on the work. With a chisel or scraper remove al superfluous solder and brighten the work with emery cloth or paper of different grades. Begin with the coarser and finishing with the fine or with flour and emery.

Why not Braze Barrels?—It was formerly the practice to braze barrels together, with spelter solder, at the breech or at both breech and muzzle, but good workmen condemn the practice, as heating the barrels to a high heat in order to melt this solder somewhat diminishes the strength of the metal, and as it is also necessary to again clean and brighten the work after brazing, and to perfectly brighten the flats where they lie together is not so easy a matter. In the life of the gun, it was found to be of no real benefit to thus braze them, as the parts were securely held in place if well soldered with soft solder, and of late years but very few barrels have been thus brazed.

Select solder of good quality, put the work well

together, and the barrels will remain firmly and rigidly in place, and will not be separated except by unfair means.

Percussioning.—The term Percussioning is used to designate the operations of drilling, and finishing the cone or nipple seat, tapping, putting in the tube or cone (by some called nipple) and otherwise finishing up the parts bearing relationship to the cone seat.

The first operation, after ascertaining the locality where to drill the hole for the nipple, is to drill this hole. If a double gun the nipples must be inserted as near the centre of the breech as possible to get them and have a direct communication, with no unnecessary angles, in the passage-way of the flame of the cap to the powder in the chamber. From the bottom of the hole drilled for the nipple a small vent, as small as can conveniently be made, must or ought to communicate directly to the powder chamber. The nipple ought to be seated or screwed to the bottom of the hole and the vent be an unbroken continuation of the opening through the nipple. Let there be no chamber or reservoir between the bottom end of the nipple and the bottom of the hole in which it is screwed.

But to return to the drilling. From the axial or central line of the barrel, the hole must be drilled at an angle of forty-five degrees so that the nipple when inserted shall stand at that angle. In the cut Fig. 33, *a* represents the central line of the barrels, *b* a line at right angles to this, and *c* the angle of forty-five degrees. If the workman have no lathe and is necessitated to use a bit-stock or breast drill, a piece of iron can be fitted to lay upon the barrels with one end elevated three or four inches with the end turned

FIGURE 33.

at an angle in a hole drilled in this end to receive the drill, which should fill the hole. By clamping this upon the barrels, inserting the drill in the hole and having a prick mark where the hole is to be made for the nipple, it forms a reliable guide to insure the correctness of the hole, and also to get any number of holes alike. To insure the hole to be tapped or threaded properly the guide can be kept in position and the hole tapped after being cupped to form the seat.

If a lathe be used to drill the hole, a piece of wood or an iron forging can be fitted to the spindle against which the work is held and when made of the proper angle and the barrel confined upon it to drill the hole, no guide is necessary, as the drill being held in the spindle and the spindle running in its bearings operates upon the same principle as the guide clamped upon the barrels. An upright drill can be fitted with a forging or casting to hold the barrels in the

The size of hole to be drilled ought to be that of the smaller sized nipples, as in time frequent re-tappings to insert new nipples will enlarge the hole. Perhaps a broken nipple may necessitate drilling or cutting out and the thread may be injured somewhat, so that it may have to be bored out and a new thread made to receive a larger nipple.

After the hole is drilled it is cupped or a seat formed for the shoulders of the nipple to rest upon.

This is done with the tool shown in Fig. 34. The guide is used to get the proper angle of this seat, the same as in drilling. The stem at the end of the cutting portion of the tool, enters and fills the hole drilled, which insures the correct formation of the seat. The tap is held in the guide in the same manner and it follows that the thread has been made at the same angle that the hole was drilled.

Finishing Nipple Seat.—The filing and finishing of the nipple seat is one in which tastes differ or the price of the work may demand. This hint may be given, the seating tool must cut a seat large enough to receive the nipple and in fitting keep this seat full size, taking care not to allow the file to take away or reduce any portion of it. A study of this portion of different guns that may come under the observation of the workman is the best guide for forming and shaping these parts. The first effort may be to form a nipple seat from a piece of hard wood shaped like the barrel with its lump, using the drill, the seating tool and even the tap, then finish up with files, as if it were iron, and insert the nipple. Better to correct a fault in a "sham" of wood than spoil a good barrel breech.

The Vent, in Percussion Gun Barrels.—When the old flint-lock was pushed to one side by the introduction of the percussion principle, it was thought by many that there was a difference in shooting and that the flint-lock shot "smoother" than its substitute. In the percussion gun there was thought to be more recoil than in the other form of gun. It was supposed that the hermetically closing of the breech, as the firing took place, was the cause of this, and to remedy the matter a small vent was drilled near the locality of the vent or "touch-hole" of the old time arm. A few gunsmiths and many users of arms cling to the vent and could "not do without it." Some claim that this vent is of use, as it enables air to circulate through the barrel, after the ignition of the charge. While both these theories are doubted by others, one thing is quite certain, it increases the certainty and also aids the rapid ignition of the charge, as the air contained among the powder and held there in a more or less state of pressure, being so forced and held by the wadding, retards in some measure the entrance of the fire from the percussion cap. The vent allows this confined air to escape, and that is the only real and apparent good that can be accredited to it. In making these vents make them very small, and in no instance let them exceed a thirty-second of an inch. To prevent their being closed by rust or the débris of burnt powder, drill a larger hole, tap a thread in it and screw in a silver

wire and then drill the vent through the wire after it has been finished to conform to the shape of the parts adjacent

The Patent Breech.—The patent breech has been the subject of much discussion and much experimenting, some experts claiming one form to be superior to others, and then again there are those who set the patent breech aside and claim that the old flat-faced breech-pin is as good as any ever yet made. The formation of the base of the breech loading shell has been called up as evidence in favor of the latter claim. The two forms are called in question, and then the query is made, "Does not the breech loader shoot better or as well as the patent breeched muzzle-loader?" But the patent breech is in favor with the mass of those who use the muzzle-loader, and no doubt has its advantages. The attempt has been made to form the interior base of a cartridge for breech-loaders upon the model of the interior of a patent breech, but thus far has not come into very extensive use.

Form of the Chamber or Cup.—While many forms of the chamber or cup of the patent breech are in use, the most simple form, and the one easiest to make, is that of an inverted elliptical cone. This form may be represented by the shape of an acorn if it were cut off even with the top of the cup. The shape is also one that will not weaken the breech nor affect the strength of the thread where it enters the barrel. The tool to shape it is easy to make. Turn a piece of steel the exact shape the "cup" is to be and then make a cutting tool of it by filing a groove on two sides, exactly like a flat drill of the required elliptical form, but with a "bulge" or cheek left on each side, and then file a groove midway in this cheek from point to base, and make it so as to form two cutting edges on each side of the cut first made. Each prominent part must be formed into cutting edges, like the cutting edges of a conical-shaped cherry to cut out bullet moulds. The cut, of bullet cherry, Fig. 71, Chapter XXVII, shows the way to make this tool.

With this form of "cup" there is great solidity of breech, and there need be but little fear of misfire or hang-fire in shooting, if the gun be properly loaded.

CHAPTER XVII.

TOOLS FOR BREECHING GUNS...
Breeching Reamers
Breeching Taps
Breech Pin Formers

CHAPTER XVII.

TOOLS FOR BREECHING GUNS.

Breeching Reamers.—The form of breeching reamers is shown in Fig 35. The extension is supposed to fill the bore of the gun, and when it does so the tool will make a cut that is straight and true. When this extension does not fill, then slip a brass

FIGURE 35.

ferrule or a piece of tubing on it, or it may be even wrapped with a piece of card or strong paper, as mentioned in case of taps that have extensions smaller than the bore of the gun

The size of these reamers must be to suit the taps; that is they must be of a size corresponding to the tap if the thread were removed The length of the extension may be about an inch and the cutting portion of a length to correspond to the length of the breech pins, for when using them where the reamer has entered the barrel until it is flush or even with the length of the cutting part, it is evident that it has penetrated as far as it ought to go. Be careful to keep the reamer well oiled when using it to ream out a breech

In making these reamers, turn them to the size and shape, and then file four spiral flutes equidistant from each other, with a small round file, but remember to file them "right hand," like a right hand screw thread. About a quarter's turn in the length is sufficient. The end where the cutting is done must be "cut back" between each flute, so as to make a cutting edge, or lip. The flutes serve to carry the chips away from the work, and prevent clogging. Above the end of the cutting portion, the reamer may be turned down to a size a little larger than the extension, and it will be then a very easy matter to nicely cut the flutes with a round file, as directed.

Breeching Taps.—The usual diameters of rifle breech pins are three-eighths, one-half, and five-eighths of an inch; of shot guns three-quarters and seven-eighths of an inch. The thread of the rifle is generally fourteen to the inch, and the shot gun sixteen to the inch. The breech pins of military arms vary. Some are made with coarse thread and some with fine thread, ranging from ten to eighteen threads per inch. There is no arbitrary rule for breeching guns, and excepting English made guns, almost every conceivable size and thread may be found in guns that are brought in to be repaired In rifle and shot guns the fourteen and sixteen thread will be found to predominate. In unbreeching guns that have been made by "experts" of some country town, who built the arms "to order," or in overhauling guns that have been repaired at the same kind of establishments, it will not be uncommon to find threads in the barrels that have been cut with a blacksmith's taper tap, and the pin tapered to suit the thread so formed. It will be nothing uncommon to find a breech that is made to one side of the bore, or made with a crooked thread. If tapped with the taper tap, the thread may be found to be ten or twelve to the inch, according as a tap to fit the breech could be found.

Let the workman discard all such ways of breeching guns. Let him procure a set of taps of the sizes and threads as noticed at the beginning of this arti-

cle, and "stick to these sizes." If the thread in a gun be worn, and the pin be loose or leak fire, then ream out the old thread, cut it anew, and put in a new pin.

Breeching taps should be made in pairs, one tapered a little and its mate made straight and with a full thread, so as to cut full at the bottom where the thread terminates. If the first tap be not tapered a little, the thread should be nearly all removed at the end, and gradualy increased for five or six threads, when it will be of full size. A stem or projection is made as shown in the cut, Fig. 36, which enters and fills the bore of the gun and so serves to insure a thread straight with the barrel. If the bore be larger than the extension, slip over it a piece of brass tube or a ferrule of some kind, until it fits a little snug in the bore. If but little be wanting to make the fit, a piece of writing paper or a bit of card may be wrapped around it. Old-fashioned

FIGURE 37

gunsmiths have been known to wind tow around an extension to make a fit.

The diameter of these extensions must be that of the smallest bored gun in which they will be used. The extension of the shot-gun tap may be about half inch diameter. The length of the extension may be about an inch for rifles and an inch and a quarter for shot guns, the thread about an inch in length. The whole length of rifle taps may be about three and a half inches, for shot-guns about four inches.

Breech Pin Formers.—These tools are made of steel and have holes drilled through them and cutting teeth formed on one end (as shown in Fig. 37) In use it may be held stationary, and the breech-pin turned in the hole until the teeth form it to size and remove enough in length for the screw to be cut on the pin. Eight teeth are enough for the smaller sizes of these tools. If made with more teeth they are consequently finer and shallower and do not operate so well, or cannot be ground to an edge or sharpened with an oil stone if they become dull. The sizes must correspond with the size of the breech taps, or a little less than this size, as the dies used in cutting generally "raise" a thread a little larger than the work. The length of these tools may be about three-fourths of an inch or an inch, as may be best to make them. In use they can be held in a lathe chuck and the pin presented to them while running, or the operation may be reversed, the pin being rotated and the cutter held stationary. If to be used by hand, hold them in a vise or clamp, or make a fixture to hold the pin, using a bit-stock for turning them for cutting.

The advantage of these tools is that the work is done quick, the body of the pin is of the same diameter, and the shoulder where it abuts against the barrel is true with the body; using a file for the work, it is difficult to produce these requirements.

CHAPTER XVIII.

TOOLS FOR CHAMBERING BREECH LOADING BARRELS..... ...

CHAPTER XVIII.

WHEN chambering barrels for breech-loaders, the utmost care should be observed to make the chamber exactly concentric with the bore, and have it smooth and well finished. Do not trust to a drill or a flat reamer; neither will a half-round or a common fluted reamer answer the purpose. Take, for instance, a bore for a thirty-eight cartridge. Fig.

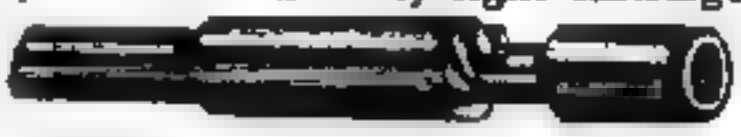

FIGURE 38.

38 shows the tool for chambering, and Fig. 39 the tool for recessing for the head of the cartridge. The diameter of the tool for chambering is thirteen sixty-fourths. The tool for recessing for the head is seven-sixteenths. The body of the cutting portion is about seven-eighths or an inch long. An extension is formed beyond the cutting part which must exactly fill the bore of the barrel and serves as a guide to insure the cutting part making the chamber in proper relation to the bore.

The neck or recess in front of the cutting part is for a three-fold purpose; it forms a receptacle for the chips or cuttings, which otherwise would clog the tool as soon as the teeth were filled, and would probably result in a rough surface by being forced between the wall of the chamber and the tool back of the teeth; it also serves to produce a better shaped tooth, which is done with a fine cut three-

FIGURE 39.

square file, and finally by the teeth being made below the surface of the extension a square cut is produced with no feather edge where the chamber terminates.

The cutting teeth of the chambering tool are made so as to produce a bevel at the end of the chamber, and by this means avoid shaving the ball, as would be the case if it passed over a sharp angle. The recessing tool is made square on the cutting end.

For larger bores than a forty-four, the tools may be advantageously made a little different, as shown

FIGURE 40.

in Fig. 40. The shank of the tool may be made of a cheaper grade of steel and the extension much smaller than the bore of the gun. At *a*, is shown a steel thimble that is turned to the proper size and has teeth cut on the end. This is tempered and is put on over the extension and held by a wire or pin passing through both thimble and extension. At *b* is another thimble, made preferably of brass, that fits the bore. It can then be worked in the barrel

with less fear of scratching the barrel, as might be the case if it were of steel or iron. The space left between the brass thimble and the teeth forms a recess to receive the cuttings. The diameter of a twelve gauge chambering tool will be about forty-nine sixty-fourths, and the diameter of the chambering tool will be about twenty seven thirty-seconds. The length of the cutting thimbles can be about one inch. The brass thimbles about three-quarters of an inch. The cutting thimbles should rest against a shoulder, as at c. These thimbles should be fastened, a finish turned on the shanks on which they are to remain, after the shanks are turned. The brass thimbles are held by being driven on the extension, and should be turned up true after being driven in place

When making these tools, form the cutter for the chamber about one-hundredth of an inch larger than the bore of the cartridge to allow for easy extraction. The brass thimbles ought to be of the size of the interior of the cartridge, which is supposed to be exactly the same as the bore. The tool for recessing the head may be a trifle larger, say about a thirty second, than the diameter of the cartridge head. If it be made one-sixteenth larger it will not matter. Eight cutting teeth are enough for these tools.

CHAPTER XIX.

On Gun Ribs.....
How to Straighten a Rib.....
How to Fit a Rib.....
How to Fit a Rib to an Octagon Barrel.....
How to Solder on a Rib .....
How to Resolder Ribs.....
Height of Ribs.....

CHAPTER XIX.

ON GUN RIBS.

How to Straighten a Gun Rib.—Gun ribs, as received from the manufacturer or dealer, are more or less crooked and winding and must be made straight before being fastened to the gun barrel. Sometimes this straightening can be done with the hands alone, by bending and twisting the rib. If there are short crooks, the hammer must be used. Select a hammer that has a flat pene and this pene must be "across" or at right angles to the handle. See that the pene is not too sharp, but smooth and rounded at its edge. Place the rib to be straightened on a piece of hard wood plank, or what is better, get a piece of two inch plank about a foot wide and long enough to reach from the floor to a height a little above the work-bench, say about the height of the top of the vise. It may be held in an upright position by means of a screw passing through it into the bench, or it can be so held by setting it on the floor and clamping one side between the jaws of the vise. On this hold the rib, lengthwise with the end of the plank, and using the pene of the hammer, strike blows on the inner or curved side of the rib. Do not strike hard enough to dent or bruise the rib so as to show on the opposite side. By a little practice a rib can be made very straight and true.

How to Fit a Rib.—Sometimes one side of a rib is longer than the other. Fit it into a properly shaped groove in a piece of board, clamp it so as to hold firmly and file away the longer side so as to match the narrow one. The clamps can be made of two pieces of wood placed on each side of the part to be filed, holding them and the rib with wood screws, the rib being moved along as a portion is filed

How to Fit a Rib to an Octagon Barrel.—To fit a rib to an octagon barrel, file the portion where it comes in contact, square across so as to have all the surface possible to touch the barrel. To fit it to a round barrel, file lengthwise with a half-round file, and so file that the outer edges will fit close leaving the inner edges a little open, or not quite touching the barrel A half round file for fitting ribs to round barrels should have the tang bent toward the flat side so that when the file handle is put on, it will not interfere with filing

How to Solder on a Rib.—The inner edges of the rib must be filed bright and smooth, so must that portion where it touches the barrel Bear in mind that solder will not adhere, unless the surface is made bright. This being done wet a short length of the rib with soldering acid, warm it to a proper heat in the forge fire, and with a common soldering copper, also properly heated, tin or cover the melted surface with solder. With the acid wet another distance, say about three inches, heat and tin this, and so repeat until the entire length of the rib has been gone over. Be careful to have plenty of solder adhering to the inner sides. Also be very careful not to heat the rib so as to blue or blacken it, for when so done no solder will adhere, and the surface so made must be brightened up again before going any further with the tinning.

The next thing to be done is to draw-file the gun barrel where the rib is to be fastened on, and care must be taken to have the surface bright and clean, or the solder will not adhere. Place the breech end of the barrel in a clean charcoal fire and carefully warm it sufficiently, wet with the acid, and with the soldering copper tin over where it was draw filed

Two tests can be applied to learn if the barrel be sufficiently heated. One is that when a drop of acid is put on it will "sizzle" or boil; the other test is to hold it close to the cheek and if a warm "glow" of heat is felt from it, it is hot enough

When the surface is tinned, and before the barrel is cold enough so as to harden the solder, wipe off the surplus with a rag, and if the rag be slightly oiled, it will operate all the better The solder used is common soft solder such as used by tinsmiths. Repeat the process of heating and tinning three or four inches at a time, until the entire length of the barrel has been gone over. Then, after it is cool, place the rib in position, confining it in place with binding wire, putting it round both rib and barrel, twisting the ends pretty firmly together. Fasten the rib in this way, at intervals of about six inches, being careful that the rib is held evenly, closely and firmly to the barrel.

Now commence at the breech, heat both barrel and rib carefully, avoiding all smoke and soot, wetting

the joint on each side of the rib with the acid, touching the part with solder taken up on the point of the heated soldering copper. The surplus solder on the inner surface of the rib will flow down to the joint, between the rib and the barrel, as it is heated, and by touching the joint with the copper charged with solder, the outer edges of the joint will be completely filled, and both barrel and rib be perfectly united. So continue until the rib is soldered its entire length. When cool remove the binding wires, and wash thoroughly with warm water. This will remove the acid, which would otherwise rust the bright surface. Wipe dry and if the work is to stand for any length of time, oil it lightly by rubbing it over with a rag that is moistened with oil

The best way to remove the surplus solder at the joints is by means of scrapers. Take an old flat file, about six inches long, grind the teeth clean off on each side for an inch or two at the end, and also grind the end "square." By using this tool in the same way that a chisel is used, it is very effective A scraper made of an old three-square file with the teeth ground away at the end is also a good tool Carefully remove all traces of solder or it will show after the barrel has been used a little. If the work is to be browned, the browning will not "take" where the solder remains

How to Re-solder Ribs.—It often happens that double guns are brought in that have the top rib loosened from the barrels at the breech, and sometimes the soldering of the barrels, also at the breech, has been broken, so that they are quite separated. The cause of this is generally an effort to remove the patent breeches by some one who has not the proper appliances for the work. The barrels being caught in a vise, and a monkey-wrench, or some similar kind of wrench, applied, and as the breeches fit very tight, perhaps being rusted somewhat, considerable force is applied, and the torsion or twisting so occasioned starts and separates the parts as described.

To re-unite these parts, remove the breeches, carefully raise the rib as far as can be done without bending it, and hold it thus in place by inserting a slip of wood so as to retain it. Use a slim-pointed scraper and scrape bright and clean the surface of the rib, and both barrels, where the rib comes in contact. Tin the parts with a heavy soldering copper, but do not put them in the fire to heat them; rely solely on the heat of the copper, taking time to do the work. When nicely tinned, put the rib in place, confining it with binding wire, and finish the soldering in the forge fire, the same as when putting on new ribs.

Before putting the rib in place, fill the space between the rib and barrels pretty full of solder, cut in strips, like pieces of wire. If necessary, use the copper to assist the soldering, as they are being worked in the fire

A scraper for such work may be made of a small three-square file, say about four inches long; grind the sides so as to remove the teeth, and sharpen to a point.

As a precaution against starting the rib from the barrel by heating, put pieces of binding wire tightly around, both above and below, twisting them tightly. With this security there will be no harm done even if the solder be melted between rib and barrel, in proximity to the thimble.

Height of Ribs.—The only way to ascertain the proper height of a gun rib, when put on the barrels, is to take the length of the barrels, and from this length make the calculation, as different lengths require some difference in height of rib. It is to be supposed that forty yards is the distance from the shooter to the object fired at, and at this distance a heavy charge of shot will drop about twelve inches. As the sights on shot guns are fixed, it is necessary that the rib be so elevated as to compensate for this dropping of twelve inches. Of course a lighter charge of shot will not drop so much as the heavy one, but the calculation may be based on the heavy charge.

To ascertain the elevation at the breech, take the thickness of the breech and muzzle and multiply the difference by as many times as the length of the barrels is contained in the forty yards. This gives the elevation of the barrels without the rib, and the difference must be made out by elevating the rib. Many shooters complain that when their barrels have been shortened the shooting is not the same, and they lay this fault to the barrels being cut shorter, when it is often due to the difference of elevation from that they were accustomed to use. Suppose a pair of barrels were to be shortened, say, four inches, at the same elevation there will be more lengths in the forty yards, hence a difference in the sighting and consequently in the shooting.

The calculation for the elevation of ribs is the same as that given for fitting barrels together, and the same principles there given will apply to this subject.

CHAPTER XX.

ON THIMBLES

On Thimbles 364
How to Make Thimbles 364
How to Put Thimbles on Barrels 365

How to Make Thimbles.—What is called a thimble by gunsmiths is the short tube, soldered, or otherwise attached to the gun barrel, which retains the ramrod in place when not in use. To make these thimbles, form them on a piece of steel about a foot long, turned tapering; the large end being about nine-sixteenths, and the small end about five-sixteenths of an inch in diameter. This will answer for about all sizes of wooden rods as they are purchased. These rods are generally, the largest of them, about five-eighths of an inch diameter at the large end and about three-eighths at the small end.

The thimbles may be made of brass, iron, or German silver, according to taste, but iron is gener-

ally preferred. Take common sheet or Russia iron, the same as used for making stove-pipe. The best thickness is about twenty-two or twenty-three, by the English gauge. For convenience, get the sheet cut in strips from an inch to an inch and a-half in width—the tinsmith's squaring shears being a ready means to cut up the sheet into strips. Generally make the upper thimble about an inch and a half long, and the lower or middle thimbles be these one or two, a little narrower, say, about an inch. For permanency and looks a long thimble is preferable. Cut off pieces from the strips of sheet-iron, just long enough to go around the ramrod, then roll them up like a tube by bending them around a tapered steel rod, using a small hard wood mallet for the purpose, holding them in the vise to assist in the operation.

For rifle rods, which are not tapered, the thimbles may be rolled up on a straight piece of steel, a trifle larger than the rod, so that the rod will slide easily within when put in place. Take pains in forming them, so that the fold or joint will come evenly and squarely together.

How to Put Thimbles on Barrels.—File bright and tin the thimbles where they are to be joined to the rib. Observe if the thimbles fit the rod properly by putting the rod in them and then inserting the rod in place in the gun stock. Mark the place on the rib or barrel where the thimbles are to be fastened, and remove both rod and thimbles from the gun. If to be attached to a rib, file a spot the length of the thimbles where it was marked, and file it of a depth equal to the thickness of the metal of which the thimble is made. Too deep filing may cut through the rib, and too little filing will leave the thimble projecting above the rib, so that the rod will hit or rub as it is being pushed down in place. Also let the joint of the thimble come in the centre of the rib when it is soldered in place. Tin the places filed, by heating the barrel carefully over the forge fire, using the soldering acid as for tinning the thimbles. A common tinner's soldering copper is best to apply the solder.

When the barrel is cool enough to handle put the thimbles on the rod, and the rod in place as it is intended to be when finished. Confine the thimbles to the barrel with pieces of binding wire, using two pieces to a thimble, one at each end. By putting the rod into the thimbles and confining them thus, there is no danger of their being "askew" after being fastened, and by putting on two wires there is less danger of their moving while being soldered to the barrel.

Make a clear fire in the forge, using charcoal if it can be obtained, heat the barrel very carefully until small pieces of solder will be melted when placed on the inside of the thimble. Have the soldering copper heated, and by using it and applying the acid an even amount of the solder can be applied to the joint outside the thimble where it joins the barrel. When all are soldered let the barrel cool, remove the binding wires and wash with warm water to remove the acid flux, which would rust the work. A stiff brush is best to wash with. Scrape off the superfluous solder, rub the thimbles bright with emery-cloth, or let them remain the black color, as may be desired.

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Gain Twist Rifling Machines 368
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CHAPTER XXI.

ON RIFLING OF GUNS

Importance of Rifling.—In a rifle the grooving is of the utmost importance; for velocity without accuracy is useless. To determine the best kind of groove has been, accordingly, the object of the most laborious investigations. The ball requires an initial rotary motion sufficient to keep it "spinning" up to its range, and is found to gain in accuracy by increasing this rotary speed; but if the pitch of the grooves be too great, the ball will refuse to follow them; but being driven across them, "strips"—that is, the lead in the grooves is torn off, and the ball goes on without rotation. The English gunsmiths avoided the dilemma by giving the requisite pitch and making the grooves very deep, and even by having wings or lugs cast on the ball to keep it in the grooves—expedients which increase the friction in the barrel and the resistance of the air enormously.

The American gun-makers solved the problem by adopting the "gaining twist," in which the grooves start from the breech nearly parallel to the axis of the barrel, and gradually increase the spiral, until, at the muzzle, it has the pitch of one revolution in three to four; the pitch being greater as the bore is less. This gives, as a result, safety from stripping, and a rapid revolution at the exit, with comparatively little friction and shallow groove marks on the ball, accomplishing what is demanded of a rifled barrel, to a degree that no other combination of groove and form of missile ever has. There is no way of rifling so secure as that in which the walls of the grooves are parts of radii of the bore. They should be numerous, that the hold of the lands, or the projection left between the grooves, may divide the friction and resistance as much as possible, and so permit the grooves to be as shallow as may be. Fig. 41 represents grooves cut in this way,

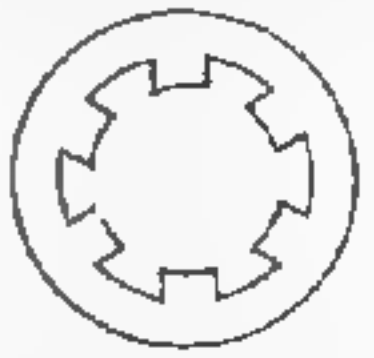

FIGURE 41.

but exaggerated to show more clearly their char-

acter. In the Kentucky rifle this law is followed, except that for convenience in rifling, the grooves are made of the same width at the bottom and top, as shown in Fig. 42, which is, for the grooves of the depth of which they are generally made, practically the same, the depth in the cut being two or three times that generally used.

U. S. Rifling Machines.—The rifling machines in use by the U. S. Government at the Springfield Armory for cutting their grooved rifles may thus be described. The barrel is placed in a horizontal position in an iron frame, and held there very firmly. The grooves are made by three short steel cutters placed within three mortices, made to receive them, near the end of a steel tube which is moved through the bore of the barrel by slow rotary and progressive motion. The cutters are narrow pieces of steel having upon one side three angular shaped teeth about one-sixteenth of an inch

FIGURE 42

in height, and of the width of the groove, ground to a very sharp edge at the top. It is these which produce the rifling. The three cutters, when inserted in the tube, form upon their inner surface a small opening which decreases toward the inner end. Into this is inserted a tapered steel rod, and is so controlled by a connecting cog-wheel that this rod is pushed, at every revolution, a little further into the tapered opening formed by the inner edges of the three cutters. The effect of this is to increase the pressure of the cutters upon the inner surface of the barrel, and thus gradually, at each stroke of the machine, deepen the cuts as produced by the rifling. The rod makes about twelve revolutions in a minute and it occupies about thirty minutes to rifle a barrel.

Old-Fashioned Rifling Machine.—But the gunmaker who builds rifles to order, and perhaps then but a single one at a time, uses quite a different apparatus for rifling, although the principle involved is the very same. Many of the old gunsmiths made their own rifling machines. The simplest form was a common joist, two inches thick and six inches wide. The length about twice that of any barrel to be rifled At one end, on the narrow side, was fixed in two bearings, one at each end so as to turn freely, an old rifle barrel. At the other end of the timber, in a line with the barrel was fixed two standards in which to firmly fasten the barrel to be rifled. At the end of the old rifle barrel, and on the end nearest to the end of the timber was fixed a circular plate of iron, like a wheel which was made with divisions on its circumference, and had a catch which was fastened to the wood, and when the end of this catch engaged one of the divisions it would firmly hold the barrel in place. When this plate was turned the barrel also turned. Inside of this barrel was placed a rod of iron, around which was cast some soft metal, as babbit metal or old type metal, or even lead. This was done by putting the rod in the barrel and then pouring in the metal when melted. A handle, similar to an auger handle was fixed transversely to one end, but in such a manner as to turn around freely on the rod. As the rod was pushed back and forth the soft metal followed the rifling grooves, and thus caused a turn, first in one direction and then in another. By the rod being loose on the handle the hands were held in the same position.

The rifling rod was attached to the opposite end of the rod in the old barrel and carried a cutter let into a narrow groove made in the extreme end of the rifling rod. Very often these rods were made of wood like a straight ramrod. It is evident if a barrel be placed in the clamps and the rifling rod bearing a suitable cutter be entered in the bore of the barrel and the rod thurst forward by pushing it with the handle, that a faint spiral like cut will be the result. When the cutter had done its work, or done all that it would cut, the plate was turned one division, rotating the old barrel with the rifling rod just that amount, the barrel to be rifled, of course, not being turned at all. Another cutting was done like the first one, then another, and so on until the complete circle of the divisions had been made, and a certain number of faint rifles made in the fixed barrel. The cutter was then removed from its slot, a slip of writing paper placed in the bottom of the slot and the cutter put in place and a repetition of the same operation gone over again, and then repeated until the rifling was of the desired depth. Oil was supplied to the centres while going back and forth in their work.

Gain Twist Rifling Machine.—What is called a gain twist was made with a slightly different apparatus. What is termed a "lead" was fixed so as to revolve in standards, and at the same time be capable of being thrust forward and pulled back to its starting place. This lead carried at one end the rifling rod. At the opposite end the handle for operating it, was fixed. The lead was several inches in diameter and the holes in the standards that supported it of like diameter. One make of lead had a groove cut spiralling in its surface and exactly the same as the rifling to be made. In one of the standards a stud was fixed that entered the groove and compelled it to turn according as the groove was made. The barrel to be rifled was fixed so as to turn as needed to make the different rifles or grooves. Another make of lead had a rib made of a strip of hard wood that was bent around the rod and was held in place by screws. This rib was the counterpart of the rifling and was received in a mortice cut for it in one of the standards, the management of the rifling rod being the same in all

Re-rifling.—One method of re-rifling is to make a rod with a mortice in one end to receive a rifling cutter or "saw" as some term them, and fix at the other end a handle like an auger handle, but so fixed that the rod will turn around freely no matter how the handle may be held. This rod is inserted in the barrel to be re-rifled and the cutter forced through one of the rifles, which must be deep enough to force it to follow its direction when pushed forward and pulled back until it would cut no more, it would be placed in another rifle and so continued until the circuit of the rifling is made. A slip of paper is then put under the cutter and a repetition of the process made and continued until the rifles are cut as deep as desired.

If it be feared that the rifles, opposite to those where the cutter is at work, will be injured by its bearing upon them, a dove-tailed groove is made across the rod opposite where the cutter is placed, and in this is fitted a slip of wood that is cut to fit the curvature of the base of the barrel. If a bit of half-round file or a cutter be made to be inserted in place of the slip of wood, the lands can be finished at the same time that the grooves are being cut deeper.

When barrels are so worn that the rifles have not depth enough to hold the tool described for re-rifling, another process must be resorted to. Make a rod of hard wood about six or seven inches long and so as to slide easily through the barrel. In one end of this fix the cutter. Around the other end cast lead or other soft metal so as to fill the rifles. It is evident if this short rod be forced through the barrel by means of a longer one, that it must turn with the rifling, being so forced to do by the soft metal engaging the several rifles. The operation of working being the same as previously described.

CHAPTER XXII.

On Gun Locks
Quality of Locks.
The Back Action Lock.
The Bar Lock
Side Action Lock
The Wesley Bar Lock
The Central Lock
Cleaning Locks, etc
How to Take Down a Lock.
To Clean and Oil the Lock.
How to Put up a Lock

CHAPTER XXII.

ON GUN LOCKS.

Quality of Locks.—It is impossible to judge the quality of a gun lock by a mere examination, for if the metal be not the very best and the workmanship be also good, some portions, as a spring, may grow weak and in an unguarded moment give way. If the mainspring be not thoroughly tempered it may break the first time it be used on a frosty morning. It is well to see if the attachment of the stirrup or swivel be well made and fitted, as this controls the movements and play of the mainspring. The fitting of the sear spring on the sear is important. If too much cramped, it may give way; if not enough cramped, then it may grow weak and there will not be that sharp, clear click that the admirer of a good lock likes to hear.

On the hanging of the swivel or stirrup depends the smoothness of play of the mainspring. On the placing of the hole for the sear pin depends the sweetness of the sear operating on the tumbler. On the pitching of the sear depends the cutting of the notches of the tumbler, and on the formation of the first notch depends the liability of the lock catching at half-cock when the trigger is made to be easily pulled from the full cock notch. On the formation of the half-cock notch depends the safety of carrying the arm at half-cock.

The Back Action Lock.—There are various forms of gun locks, and each form has its admirers. The back action shown in Fig. 43 admits of the arm being put together more strongly and securely than any other plan. Other advantages claimed for it

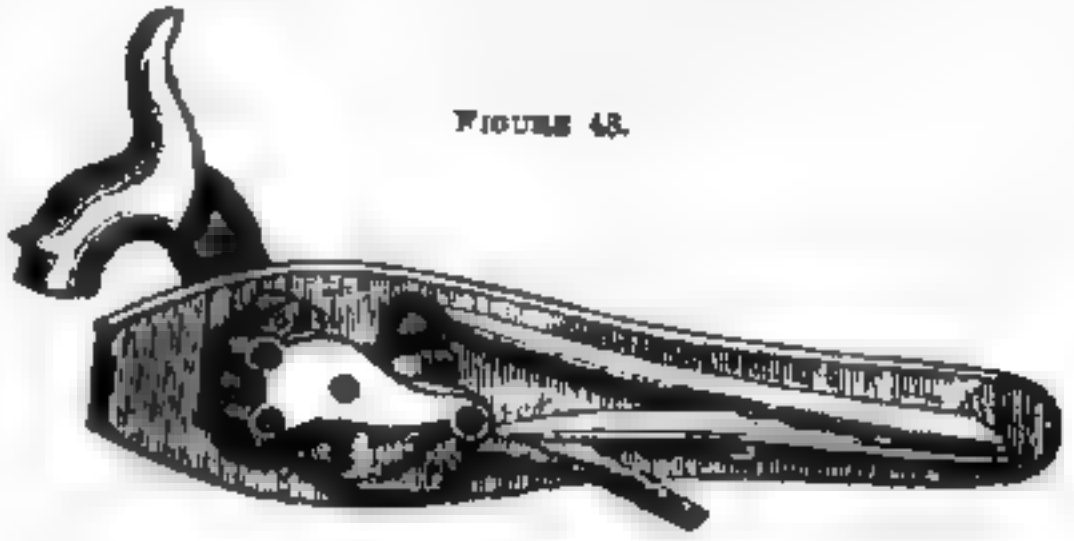

FIGURE 43.

are that the mainspring can be made longer and will therefore be less liable to break, and by such length has a smoother working motion to the hammer. As the lock plate is almost entirely surrounded by the wood of the stock, there is less liability of wet getting into the interior, and this may especially be the case as the hand, in carrying the gun, covers some portion of the lock.

The Bar Lock.—This lock, Fig. 44, is so called from a bar formed at the breech end of the barrel, and to this bar the lock is fitted. The great advantage of this lock is that it admits of the stock to be so shaped that the grasp of the hand naturally tightens as the gun is raised to the shoulder. The objection raised by some to this lock is that it is more pervious to wet than the back action lock.

This lock possesses the advantage of having an arm of the tumbler so made that by the swivel or

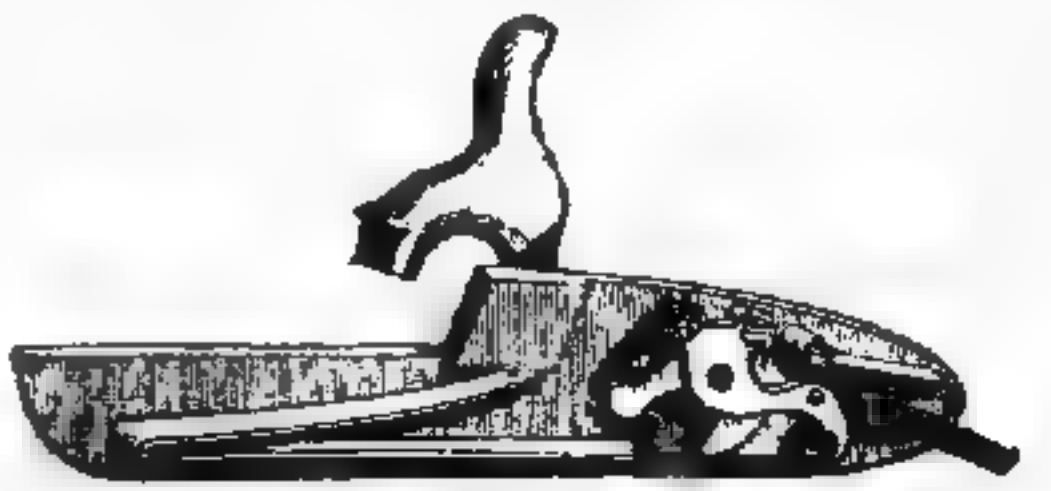

FIGURE 44.

stirrup being hung upon that when the lock is at full cock the weight of the spring force is lessened by

the arm acting as a lever to bring the moving force in the immediate vicinity of the axis on which the tumbler turns, and when the spring is bringing the hammer down on the nipple, increasing that force by divergence. It is sometimes called the Full Bar Lock.

Side Action Lock.—In Fig. 45 is shown another form of lock, commonly called a side action. The mechanism and arrangement is similar to the full bar, but it has a shoulder that fits up to the barrel. If the gun be fitted with a plug or cylinder a suitable half round recess is cut in this shoulder to receive the plug.

The Wesley Bar.—The Wesley bar shown in Fig. 46 differs from the common bar lock by being of different shape at the fore end, and this end does not fit up to the barrel like the bar lock. By the wood

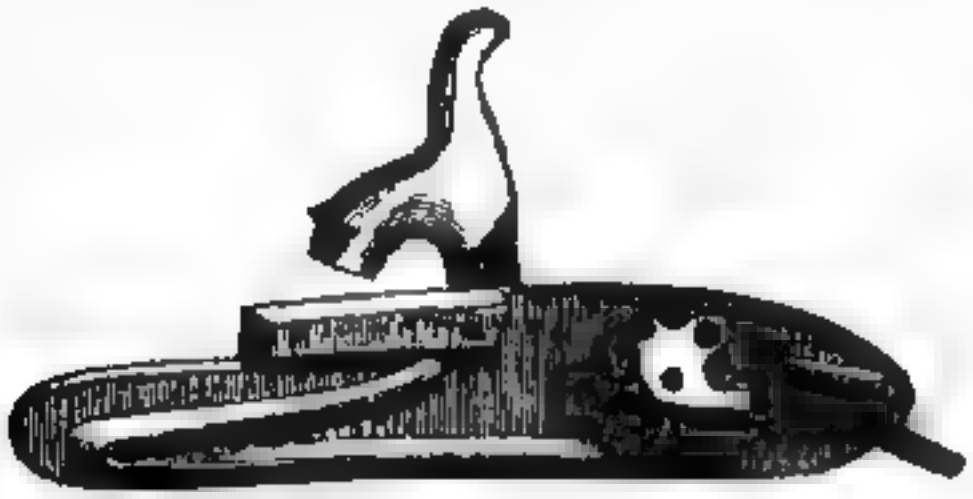

FIGURE 45.

almost surrounding the plate, the interior is pretty well protected from wet. It has the same merit of the stock being so shaped as to tighten in the hand when raised to take sight. This lock has one objection, the wood between the lock-plate and barrel has to be cut so thin that the recoil of the gun is very apt to break and splinter it.

The Central Lock.—There is a grade of guns made with locks enclosed in the breech, or a continuation of the breech, in the same manner as common revolvers and other pistol locks are made. A view of this lock is given in Fig. 47. The principle is much the same as the back action lock when the hammer is placed on one side as in the back action lock. One side of the frame has the same office as the lock plate, and the other side supports the tumbler and other parts the same as the bridle. The formation of the tumbler is such that no sear is necessary, the trigger bearing directly against it;

FIGURE 46.

the point of the trigger having the same office as the nose of the tumbler, a small spring keeping it to place to catch in the tumbler notches. Generally this form of lock has the hammer placed directly in the central line of the bore of the barrel, and when so placed the lower end of the hammer has the same office as the tumbler and is shaped and has notches cut as in a side lock tumbler. As this form of lock has few parts, and has a long feather-like mainspring, it is easy and pleasant to operate.

Cleaning Locks, etc.—While the gunsmith will be called upon to clean and repair various parts of firearms, the lock is the part with which he will have considerable to do. And, in most kind of guns, it is the most complicated part, and, consequently, the most difficult part to manage. Not a few gun-owners look upon it as a kind of mystery without the range of ordinary comprehension, hence they carry it to the shop, not only at the slightest indication of "something wrong," but so often as it would seem to need thorough cleaning and oiling. This is all well enough, for the gun as much as anything comes clearly within the application of the rule which admonishes that "a stitch in time saves nine." All of which being the case, one of the earliest things that the gunsmith will be called upon to study will be

FIGURE 47.

How to Take Down a Lock.—Having removed the lock from the gun, set the hammer at full-cock. Apply the hand-vise, or mainspring clamp, if he has one, to the mainspring, having first placed a bit of chamois skin or felt between the jaws of the vise and the spring to prevent bruising or scratching the polished surface of the latter. Turn up the vise gently until the hammer feels loose. Now press upon the sear-spring and let down the hammer. The mainspring is now entirely loose, and may be lifted out with the vise. This ends the complication of the lock; it is now only a plain machine, with parts held into position by screws, which may be removed one at a time until every piece has been taken from the plate.

In taking down a lock the beginner should work slowly and cautiously, thinking in every case before acting. His screwdriver should be pressed well-down in the notch of every screw to prevent damage to the head, and if he apprehends the slightest danger of getting "things mixed," he should lay each screw and its piece in different places upon his bench. Of course, there will be no such necessity after a few locks have been taken down, but such a necessity might exist at the very beginning; at least there is no harm to grow out of taking what is known to be the safe side in every case.

The directions given for taking down, refer to the common lock, while locks of some of the modern guns will be made on plans quite different. But the principle will be the same, and hence there is no reasonable demand for going into further detail.

The first object will be to get control of the mainspring so that it can be lifted out with ease. This attained, and all the rest of the work is easy enough.

To Clean and Oil the Lock.—Botches usually wipe the old oil and dirt from the parts with a rag, put on fresh oil, and then put the lock together again. This is a poor way, for a portion of the old gummy oil will be left to combine with the new, thus soon making it about as bad as the old. Every part should be thoroughly cleansed and dried before any new oil is used. First wipe the dirt and old oil off as thoroughly as possible with a piece of cloth or felt, and then rub it over with powdered chalk or Spanish whiting. Next brush off and rub with a stiff brush such as is used by jewelers or watchmakers. This will remove all the old oil, after which the new oil may be applied.

Cases may turn up in which the lock has been long neglected, and the oil and dirt have gummed together so badly as not to admit of wiping off. In such cases the parts should be soaked for a short time in kerosene or in benzine, which is still better. This will dissolve the gum and render it easy of removal.

In oiling, only oil enough should be applied to lubricate the parts—there is much more danger of getting on too much oil than too little. It should be put on with a stubbed camel's hair brush or pencil, as the painters call it, and with extreme lightness. And there is but one kind of oil fit to be used on a lock, the very best "watchmaker's oil" obtainable. Such an oil is comparatively costly, but a single bottle, costing 25 cents, will oil hundreds of locks, hence the cost is really not entitled to consideration, on account of its being so decidedly superior to any other oil in use.

How to Put up a Lock.—In taking down the lock the last thing removed was the sear-spring, perhaps—it is most convenient to make that the last thing. Now, in putting up the lock, that is the first part to claim our attention. Screw the sear-spring into position, then the sear; next put in the tumbler, and then put on the bridle. Having this all right, screw on the hammer and let it down. Then take the mainspring, clamped as it was at the taking down, hook it on to the swivel, and bring it up until the little steady-pin is in its hole in the plate. Now unscrew the vise and the lock is ready for work

It will be necessary to always handle the mainspring with care. It is the first thing to come off in taking down, and the last to go on in putting up the lock; and the vise or clamp must be turned upon it only just enough to bring it loose, and no more. If more, it may be damaged, possibly broken.

Handling the parts of a lock with chamois skin or paper, is a good idea, while brushing off the chalk and rubbing them clean with the brush, and it is also a good idea not to touch them with the naked fingers afterwards. Few gunsmiths would be inclined to take this precaution, but it is worthy of consideration if one desires to be ranked among the very best and most careful of workmen; as handling with the naked fingers is apt to leave the parts in such a condition as will cause them to eventually rust, slightly at least.

CHAPTER XXIII.

On Fitting Gun Hammers. ....
To Fit a Hammer on a Tumbler ....
The Drift for Squaring the Hole. ... ...
A Tool for Fitting Hammers... .. ..

CHAPTER XXIII.

ON FITTING GUN HAMMERS.

To Fit a Hammer on a Tumbler.—To file the hole in a gun-hammer so that it will rest firmly and evenly upon the squared end of the tumbler, has tested the skill and patience of nearly every gunsmith. The usual practice is to drill a hole nearly the diameter of the square of the tumbler, then file this hole until it fits the square, and unless skill and patience are brought into requisition, and a nice fit be the result, the hammer soon works loose, then needs refitting. The remedy then generally is, remove the hammer from the tumbler and close the hole a little by cutting around the squared opening a little distance back from the edge, with a sharp cold chisel, thus throwing some of the metal inward, closing the hole a trifle. The hammer is then put upon the tumbler, and if it be a little tight is driven to place with a hammer. After some usage it becomes loose again, and has to be again refitted.

It is evident that unless what might be called a "perfect fit" be made, that the sudden arrest of the hammer upon the tube or cone, as it descends by force of the mainspring, will cause some slight displacement of metal where the hammer and tumbler come in juxtaposition. A repetition of these sudden arrests increases the displacement, and often there is considerable looseness of the parts.

The Drift for Squaring the Hole.—The remedy for this is very simple, and can be performed with but little labor. After the hole in the hammer is drilled introduce the end of a square drift, and drive it steadily through with blows of a hammer. The drift will cut a clean hole, the exact counterpart of its form, and this hole will need no finishing, if the drift be properly made to insure its correctness as to being smooth and true. Bear in mind that while driving the drift, the work must rest evenly and

FIGURE 48.

solidly upon some firm support, but in such a way that the tool will easily pass through. The drift is shown in Fig. 48. In construction it is a rod of steel filed or so shaped that its tranverse section is of the precise form that the hole is to be made, and too great care cannot be taken to insure its being as correct as possible. The entering end of the tool should be made round, and almost fill the hole as drilled in the hammer, and it should increase gradually in size until it arrives at the full proportions and then gradually decrease to the upper end, so that it will readily pass through the opening made by the larger

portion. On the sides of this tool are cut teeth that extend around it, being continued from side to side after the manner of a screw thread upon a bolt. It will be observed by reference to the cut that the teeth commence on each side of the square and resemble a four-threaded screw, with saw-shaped teeth, made upon a square rod. A file is the most ready tool to cut these teeth. Forge the steel carefully, temper equally, and do not leave too hard. When properly made it will last for an untold amount of work.

The number of cuts or teeth to the inch may be about ten. There must be sufficient depth between the teeth to receive the cuttings, and they must be made strong enough to withstand the hammer blows. In driving use oil on the teeth, and be careful to keep it upright, so as to form a hole that will enable the gun-hammer to stand properly on the tumbler.

If it be feared that there will be a variation of the hole from the "square," turn the drift a quarter turn after the first driving and drive again; then turn another quarter and drive the third time, and so on of the fourth.

The drift may be made of almost any shape, and will produce holes of irregular form as readily as square ones. Another example is the mortice in the loop attached under gun-barrels, through which the bolt passes, and also the same size mortice or slot in escutcheons, which are let into the stock, through which the same bolt passes. The holes in small solid wrenches to receive square or six-sided nuts can be readily and easily made in the same manner.

A Tool for Fitting Hammers to Gun Locks.—The usual practice in fitting hammers to gun locks is to measure with the dividers the distance from the centre of the tumbler, where it projects beyond the lock-plate, to the centre of the tube or cone, and so get the length of the hammer; then drill the hole in the hammer, square this hole by the rule of "guess," and file until it fits upon the square of the tumbler.

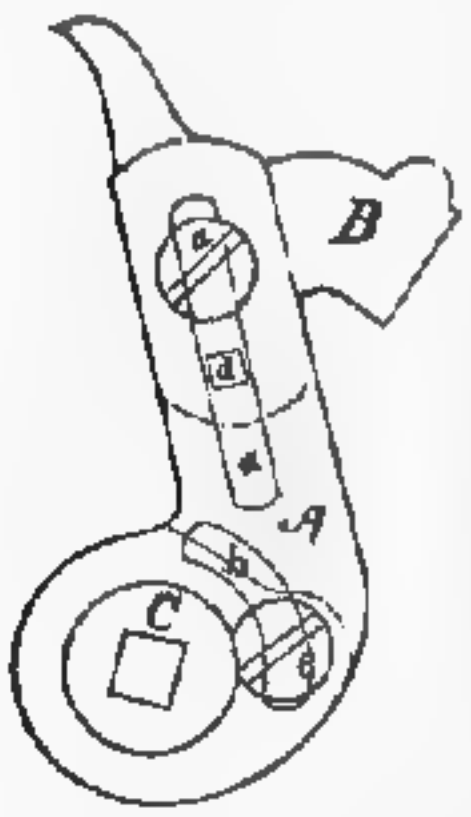

FIGURE 49.

A simple tool can be made by any gunsmith, that will greatly facilitate his operations in fitting hammers. The accompanying cut (Fig. 49) shows this tool in full size. It is made of iron or steel, one-eighth of an inch thick. The body, A, of the tool is one-half inch wide, and has a slot, *a*, three-sixteenths of an inch wide and one inch long. The curved slot, *b*, is the same width, and embraces about one-fourth of a circle. The nose-piece, B, is shaped like the top portion of a hammer, and is held to the body, A, by a screw, *c*, and to insure its moving in a line, and being held properly in the slot, *a*, there is a small stud, *d*, that fills the slot. In the lower curved portion of the body, which is seven-eighths of an inch in diameter, there is a five-eighths hole, which receives the round portion of the piece, C. This piece has an extension, as shown by the dotted lines, and is held to A by a screw, *e*. The square hole in this piece is intended to fit the square of the tumbler of the lock. The thickness of C, at the round part where it enters A, is the thickness of both A and B. There is a shoulder of the thickness of B, and of the size of the body of the tool at the lower end, being of the same diameter, so that the back surfaces of B and C are of the same thickness. The front surface of C is flush with A.

To use the tool, put the square of the lock tumbler in the square hole of C, and put the tumbler screw in place. Loosen the screw, *e*, and turn the piece, C, until the nose of B will rest pretty firmly on the gun-tube; then turn the screw to hold it in place. Loosen the screw, *c*, that holds B in place, and move this piece up or down until the centre of the nose rests squarely on the tube; then confine it in place by turning up the screw, *c*. This is now an exact pattern, giving the length, shape of the hammer, and also a guide to form the square where it fits the tumbler

It must be observed that the screws and the stud, *d*, ought to fill the slots on the shoulder of the piece, C, a good fit, so that it will turn evenly and properly in the hole of A. The screws may be the same that are used for tumbler screws for army muskets These screws are hardened, and, as they have large flat heads, they answer for this purpose very well.

The part, C, can be made of two pieces of the same thickness as the other parts. Finish them separately, except the square hole, and then solder or rivet them together. The square hole is best finished up when the two parts are fastened together.

CHAPTER XXIV.

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CHAPTER XXIV.

ON NIPPLES OR CONES.

The terms nipple, cone and tube are applied in rather an indiscriminate manner to that portion of a gun breech on which the copper cap containing the fulminate designed for firing the arm is placed. To be good and serviceable, the nipple should be made of steel, and carefully tempered, but many are made of a low grade of steel, of common iron, and even malleable iron has been used, and case-hardened to render them fit for use

Forms of Nipples. There are as many forms of nipples as there are qualities, and they may be di-

vided into classes, as the musket nipple (called "cone" by the armory operatives), the American,

FIGURE 50.

FIGURE 51.

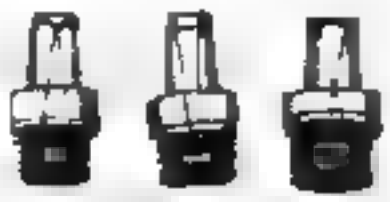


FIGURE 52.

English, and German. The German have coarser threads than the American. The English musket nipple has a thread or screw of 18 threads per inch; it has a flat top, and has a hole of one taper, being large at the bottom and smaller at the top. The American musket tube has a screw of 24 threads to the inch, has a vent resembling two inverted cones, meeting with a small opening near the centre. The top of the nipple, consequently, resembles a narrow circular ring. Fig. 50 shows the English nipple, and Fig. 51 the American; Fig. 52 the different forms of vents.

Nipples for Breech-loading Arms.—For breech loading arms, using loose powder and ball, the nipple is made similar to the American, but the vent is made quite large at the top, and decreases like an inverted cone, and terminates in a small opening a little larger than a common pin. In this nipple the fire from the cap is concentrated and caused to rush with some force through the small aperture, the same as heat is concentrated in a single point by using a blow-pipe for that purpose. The object is to burn through the material of which the cartridge is composed.

Nipples with Flat Tops.—The use of a nipple with a broad, flat top requires a vigorous mainspring, and then quite a volume of the detonating flame escapes outside the nipple and between it and the cap. The small portion that passes down the tube may be so impeded, if the nipple be foul or rusty, as to cause the gun to hang fire, and even to miss fire. Should the mainspring be too weak, the cap will come in contact with the broad surface of the nipple, forcing the priming of the cap from its position, and leaving it unexploded. Often the cap is made to bear the blame, when the fault is due entirely to the formation of the top of the nipple.

The American Musket Nipple.—The American musket nipple has a thin edge and a wide opening at the top, so as to allow the flame to readily enter, the thin edge enabling the cap to be very readily exploded, even with the blow from a weak main spring. In this form of nipple the detonating powder is ignited at the edge, and being forced to enter the wide opening, is compelled to pass down the vent to the powder. If there be any little dirt or obstruction, it is generally forced along with the fire, and the ignition of the powder is certain, and miss-fires are few.

When nipples are made with the small opening of the vent at the bottom, coarse-grain gunpowder can be used, as it is not necessary that the grains need to be admitted to the nipple. This is the case as regards military arms fitted with nipples. The powder is too coarse to be received in the nipple when freed from the cartridge and placed uncovered in the gun breech.

It has been claimed by some that gunpowder can be glazed too smooth to readily take fire, and this is a source of miss-fires. Also that the flame from the detonating powder will form a mass of condensed air around itself, preventing contact with the powder until the heat is expended. This was especially thought to be the fact when there was a volume of air between the powder and the end of the nipple. These two theories are presented for what they may be worth.

Nipples used in Sporting Guns.—Of nipples used in sporting guns there may be found the broad top, the countersunk top, the taper bored, the countersunk taper, the reverse taper, double reversed, etc., etc. They are generally put up with the screw portion made in assorted sizes. The threads also vary, being as coarse as 26 to the inch, and as fine as 32 threads per inch.

Preparing Nipples for Guns.—It is well for the gunsmith to test the nipples with a fine file to ascertain their hardness before inserting them in guns. If too soft, they will be returned on his hands. If there is also a liability of the gun-hammer battering the top where it strikes, which soon is so broad as to cause miss fires. If too hard, they are liable to break short off at the square, and the screw portion left in the gun is difficult to remove. Sometimes so much so that it is necessary to unbreech the gun, remove the patent breech and heat it to soften the portion of broken nipple so that it can be drilled out. In drilling there is a risk of injury to the thread of the nipple seat. The heating necessitates labor to refinish the part and it is to be again case hardened before screwing into the barrel. If found too hard, nipples can be drawn to a better temper by holding the top portion in a pair of pliers in exposing the bottom part to the flame of an alcohol lamp. If they be too soft, enclose in a short piece of gas pipe, pack them well with bone-dust, stop close the ends of the pipe, and heat to a red, letting them remain so for fifteen or twenty minutes and then open the end of the pipe to let the contents fall into water. They can be drawn to temper to suit. They may also be heated hot, rolled in prussiate of potash or cyanide of potassium, again heated, and thrown into water. As cyanide of potassium is a deadly poison, be very careful how it is used and where it is kept. Do not breathe the flames when put on hot iron, and do not let it come in contact with sores or raw places on the hands.

Remedy for Bad Nipples.—In case guns come in to be repaired because they will "not snap a cap," see if a weak mainspring be not one cause, and a nipple with broad top, another. For the latter evil, ream or counter sink it so as to have a thin cup like edge. See also if the cup of the hammer strikes properly on the nipple, and that it be not too much cupped by long usage in striking. In this case, the cup may be filled by drilling in and inserting a bit of iron or steel to fill it and then re-harden.

Pistol Nipples.—Pistol nipples, Colt's for instance, have a different thread from gun nipples. The thread used in Colt's revolver nipples is 40 to the inch. But one size is employed—nipples are sometimes provided with a thin, round washer of copper, which is put on at the shoulder where the thread terminates. This shields that part of the seat where it is placed from rust, and some claim that it acts as a sort of cushion to deaden the blow of the hammer, thus preserving the nipple from breakage.

Plugs for Nipples.—Plugs can be made from a rod of iron of suitable size that is sound and free from flaws. The size of the part that screws into the barrel is about three-eighths of an inch, and the thread is twenty to the inch. This is the size and thread generally used. There may be exceptions that will require a different size and a different thread, but, if possible, let the sizes given govern the work. The end on which the screw is to be cut can be turned in the lathe, cut down with a hollow mill in the method given for making breech pins, or it can even be filed to shape in absence of any other way to make it.

FIGURE 53

Before cutting the plug to the length where the nipple is to be seated, screw it into the barrel, mark the place for the nipple which can be found by letting down the hammer of the lock, then remove drill and fit the nipple. Cut off all that is not required beyond the nipple and screw into place, the nipple forming a shoulder on which to rest the wrench in screwing it home. The finished plug is shown in Fig. 53.

It is best to remove the barrel from the stock in screwing in the plug. With an improper wrench, it often happens that a nipple will be broken off at the square if it be very hard, and then it is difficult to remove. To obviate all danger of this, make a wrench with a handle at each end, and in the middle have a hole that will fit the plug, and then file an opening so that it will just fit over the nipple. It should fit close to the nipple at the square, and be free so as not to have a bearing at the end of the nipple where the cap is put on.

Plugs are sometimes left bright, but if blued it improves their appearance and there is less tendency to rust. If desired to be very durable, case-harden them. The better polish that can be made on them will make a better blue or case-hardened surface.

Many of the cheap plugs in market are nothing but cast malleable iron. The best material of which to make them is decarbonized steel, or what is known as "soft steel." It comes in smooth round rods and is homogeneous and easy to work. Cold-rolled iron rod makes very good plugs. The diameter may be half-inch or nine-sixteenths, the latter size being most preferable. With a three-eighth size screw the half-inch rod gives a one-sixteenth shoulder, which must fit tight to the barrel. If not fitted tight, the gas from the powder when the gun is fired will soon cause a leak which is difficult to remedy. In some localities the name plug is discarded and the term "cylinder" adopted.

CHAPTER XXV

On Springs.....
Main Springs
Sear Springs
How to Forge Main Springs
How to Temper Main Springs
Cheap Springs for Revolvers
Coiling Wire for Springs, etc.

CHAPTER XXV.

MAINSPRINGS.

Mainsprings.—Mainsprings are made for right and left side locks, and are known as right and left. Very few gunsmiths make these springs, as they are kept in stock and can be purchased of the dealers at any time. Fig. 54 is called the forward or side-action hook spring; Fig. 55 the forward or side-action swivel, and are used in bar locks.

Fig. 56 is the back-action mainspring, such as used in cheap made locks. These springs are also made

FIGURE 54.

with sear spring combined. Fig. 57 is swivel back-action with sear spring combined.

Sear Springs.—Sear springs are made for right and left hand locks. The side-action or bar-lock springs are shown in Fig. 58, and the back-action lock springs in Fig. 59. In one kind of back-action lock there is used a bent spring similar to the bar-lock spring which is shown in Fig. 60. It will be observed that the lower branch of this spring is longer than that which is used in the bar or side-action locks.

How to Forge Mainsprings.—If the gunsmith desires to forge his own mainsprings he must select a good quality of spring steel, as cast steel is gen-

FIGURE 55.

erally too quick or fiery for springs that have as severe a duty to perform as a mainspring. Get the steel of the same thickness as the mainspring and of a width equal to the spring and the pivot that goes through the lock plate.

Draw the spring out carefully over a fire that has been burned enough to free it from sulphur, if bituminous coal be used, and be very careful not to over-

FIGURE 56

heat the metal. Form to shape with any tools or means that may be at hand.

For straight springs, as some kinds of pistol and gun-lock springs, procure steel of the thickness and width of the spring at the widest and thickest end, and draw down to the requisite width and thickness of the smallest end.

How to Temper Mainsprings.—If it be a single spring that is to be tempered, heat it carefully or

FIGURE 57.

evenly in a fire that is well burned to free it from sulphur, or preferably in a charcoal fire, and when at a light-red heat, harden by plunging it in any animal oil. An iron pan may be used to contain the

FIGURE 58

oil, and any refuse or poor oil that may collect may be used. Lard oil is good, but if oil be wanting, use common lard or even tallow. If hard, melt before using.

To temper the spring, remove from the oil, and hold it all dripping with the oil over a clear fire until the oil takes fire and blazes off It is best to dip it in the oil and blaze off the second time

If there are a number of springs enclose them in a piece of gas pipe to heat them, and when hot, turn them into the oil. To temper, remove them, put

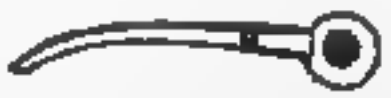


FIGURE 59.

them in an old wrought-iron frying pan, add a little oil, heat the pan over the fire, shaking it in the meantime, until the oil takes fire and blazes off. Let the work cool without putting it in water or oil.

Cheap Mainsprings for Revolvers.—Make springs for cheap revolvers from strips of sheet steel. Cut the springs so that the *length* of the spring will be

FIGURE 60.

lengthwise of the sheet from which it is cut, or, in other words, the *grain* of the steel must *not* be across the spring, but *lengthwise* with it.

When fitted, harden in oil and blaze off in an old sheet-iron pan; an old frying pan being very good for the purpose, and literally *fry* them in the oil. If heavy, blaze two or three times. Agitate well in the pan during the blazing process.

An old saw blade, one that is quite thin, when cut up in strips will make springs for cheap work. If too hard temper, it cannot very well be used until the temper be drawn to suit. They can be bent into form with a strong pair of pliers. By warming the strips over a fire they can be readily bent into shape. Old table knife blades, sometimes called case-knife blades, that are well tempered, have been employed, the blades being cut lengthwise with a pair of hand shears.

Coiling Wire for Springs, &c.—There are several methods of coiling wire for springs. The most simple is to clamp a rod in the vise and wind the wire around it by hand, but this is a very unsatisfactory method and it is rather difficult to wind the wire evenly. Another method is to revolve a rod in the lathe and let the wire coil upon it as the lathe is turned. To insure equal space between the coils, a piece of metal is held "behind" the wire, and as this piece of metal bears against, or in advance of the coil just made, it produces an even spring. A hook made of a piece of wire or a piece of metal with one end formed into a hook and clasping the rod on which the wire is moved is an excellent way to form an even spring. Two, or even three or more pieces of wire may be wound at one time, and this will insure springs of even space.

Another way in which a spring of even coil can be made, is to hold a bolt that has a good thread, upright in the vise and confine the wire by clamping it to the bolt, then wind the wire, letting it follow the thread of the bolt. When enough is wound, remove and release the spring by "screwing the bolt out of it," the same as if holding a nut fast in the hand and turning the bolt out of it. Springs of almost any coil, but not of "almost any diameter," can be made in this way.

In the absence of a lathe a wire winding tool may be made by bending a rod into the form of a crank and insert the long end through a piece of hard wood, as shown in Fig 61. This can be held in the vise to use, or fastened by two or three screws to

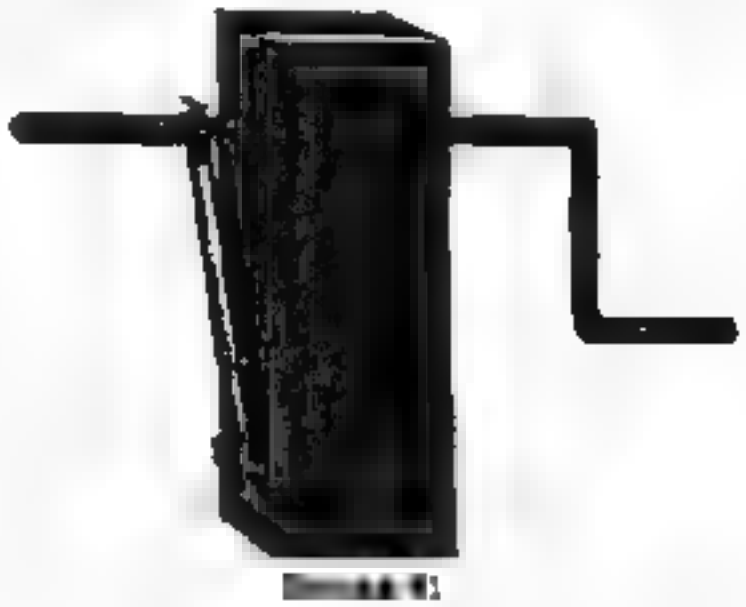


FIGURE 61

the bench or any convenient place. A slot is made

in the end of the part that projects through the wood, and in this slot the end of the wire is placed and is wound *toward* the crank. Of course the spring can be made no longer than this projecting end. To make different sized springs different sized rods must be used, and holes to fit must be made through the piece of wood.

To insure even space between the coils, a strip of thin steel may be fastened by one or two screws at or near the bottom of the piece of wood, and a hole is made near the top of the winding rod to pass through. A space is cut out, as shown in the cut, to admit of the wire being removed. In winding the upper end the steel strip is held away from the wood by its spring, or by a wooden wedge, and the wire must be held close to the wood by the hand or by a piece of wire formed as a sort of staple. To wind a very long spring, or a spring longer than the rod, a clamp may confine the wire to the rod, and when the spring has been wound to its length, remove the clamp, draw back the winding rod, fix the clamp close to the outer end and begin to wind again without cutting the coil, push it off the end of the rod as it is filled each time. As all wire, like hard drawn brass or steel wire, will "spring open" after being coiled, the rod must be made much smaller than the spring to be formed. Different sized holes may be made in the same block of wood to receive different sized winding rods over.

Hooks or eyes on the ends of the rods can be readily made in like manner. When the rod is too large to admit of ready bending to form the crank to turn it with, a crank of cast-iron can be riveted upon it.

If the mechanic wishes to make a tool of this kind, that will be more serviceable and at the same time "look like something," he can procure a casting similar to the movable head of a lathe, and put in the hole where the spindle is placed a similar spindle, but with the end where the wire is to be wound large enough to form a shoulder to keep it in place, and on the other end put a wheel eight or ten inches in diameter, with a handle to turn it with. The end where the shoulder is may be made with a screw to fit the lathe chuck or with a hole to receive the lathe tools, and they can be held there the same as holding them in the lathe chuck. The spindles to wind the wire may be inserted in the hole and held in place by the set-screw. The tool may be fastened to the bench by a rod screwed into the base, or held by a nut under the bench.

This tool will be found to be a very ready one with which to work out bullet moulds. The cherry being held the same as a rod. It can also be used to free the muzzle or breech of barrels, using the wooden rods covered with emery, as described in Chapter XVI. It is also useful for reaming holes and can be used for drilling in case of an emergency. As a tool for holding taps to tap the thread in holes it has no equal—the work being held in the left hand and the wheel turned with the right hand.

[illegible] XVI.

On Rods .....
How to Make Ram Rods .....
How to Make Wiping Rods.....

CHAPTER XXVI.

ON RODS.

How to Make Ramrods —Ramrods are of two forms, the straight rod used for rifles, and the tapered rod used for shot guns The wood that is most in use is hickory, which is split and then turned into shape. The other woods used are ebony, redwood, snakewood, rosewood, etc. Rifle rods are generally made of sizes from three-sixteenths inch to half-inch diameter. Shot gun rods from one-half inch to three-quarters inch in diameter. The measurement of the shot gun rods is at the largest diameter

One way of making rods for rifles is very similar to that in which screws are made. A hollow tool is used with cutting lips, three are enough, and the rod is passed through this tool, the tool being turned very rapidly during the cutting The operation may be reversed and the wood being rotated while the tool is held in the hand and is passed along as it cuts

A better kind of tool is made like a wheel about two inches in diameter, and three-quarters of an inch thick. A hole of the size of the rod is made through the diametrical centre, and one side of the circumference is cut away so that a tool partaking of the nature of the gouge and finishing chisel is so held by a screw, that the gouge portion advances and roughs out the rod, while the chisel shaped part following it shaves the roughness and leaves the work smooth and nice. The hole through the tool must be of the size the rod is to be made, and the cutting tool set so as to allow the work to pass through the hole easily. Only one size rod can be made with this tool, and different sizes must be made for different sized rods; except the cutter which must be of steel, it can be made of cast iron.

To make rods by hand, the wood is split out as straight as can be and then rough shaved into form with a drawing knife. It is then planed square with a carpenter's plane and then the square corners are taken off, leaving the rod of octagon form. A few strokes of the plane will then remove these corners and it will be nearly round. A new file and sandpaper will finish it true and even. After the rod has been planed square, the best way to hold it for removing the corners and make it octagon form is to have a V groove made in a piece of hard wood of the length of the rod in which to lay it. Otherwise, it will be very difficult to hold while using the plane

Round straight rods can be finished with a tool like a moulding plane, and if this tool be of the proper form, and the work be turned around two or three times during the operation, a good rod can be made very expeditiously

When wood is cross-grained it cannot be planed very well and must be finished with a file and rasp

To hold the rod while being worked, get a piece of hard wood about three-quarters of an inch thick and about four inches wide; in one edge have a groove

made a quarter inch wide and three-eighths deep. Rest the rod in this groove, holding it at one end with a hand vise so as to turn it while filing, and reduce first with the rasp and then finish with a file. To finish easily with sand-paper, wrap the sand-paper around a piece of wood shaped like a file, and use as if filing.

Pieces of broken window glass may also be used to advantage in reducing rods, and then finish with fine sand paper.

How to make a Wiping Rod.—Take any straight rod, a ramrod for instance, but be sure that the

wood be strong and tough, and cut one end like the form shown in Fig. 62. By folding a rag over the end, doubling it so as to fill the bore of the gun, it will be found that it can be used in muzzle-loading guns without pulling off when the rod is being withdrawn. The rounded end prevents the end of the rod being pushed through the cloth, and the deep notch receives the folded sides so that it presents no inequalities to the bore of the gun. The square shoulder prevents its being pulled from place on being withdrawn from the gun.

An iron rod may be made in the same way, but a rod made of good hickory wood has no equal.

A wiping rod may be made of an iron rod having a slot or mortice cut through one end, and through this a rag is drawn. It may be used in breech-loading guns where it can be pushed in at one end and drawn out at the other, but in a muzzle loading gun it cannot well be withdrawn on account of the rag being folded upon itself in attempting to withdraw it.

If a wiping rag be put in a gun and cannot be withdrawn, it may be sometimes relieved so as to be withdrawn by turning a little warm water down the barrel so as to saturate and soften the rag.

Wiping brushes should not be thrust down the bore of a muzzle-loader as they cannot be readily withdrawn, and in instances where they are of larger diameter than the bore, the gun must be unbreeched to have the brush taken out. These brush wipers are very nice for that class of breech-loaders where they can be inserted at one end and withdrawn from the other. In using them in this class of guns, insert at the breech and remove from the muzzle, and then there will be no dirt or debris thrown among the breech mechanism.

CHAPTER XXVII.

On Bullet Moulds
Joints for Bullet Moulds
How to Make a Ball Cherry
Tempering Ball Cherries

CHAPTER XXVII.

ON BULLET MOULDS.

Joints for Bullet Moulds.—Simple as it may seem, the joint of bullet moulds, unless produced by the manufacturer, who has ample tools at his command, is not often well done. The want of the proper knowledge how "to lay out" such a joint may be the excuse for ill-fitting work. Yet it is easy enough, only "know how."

By reference to the cut, Fig. 63, the joint and one side of the body of a bullet mould, it will be observed that the line A is the surface where the two halves abut or come together. The line B is drawn at right angles to this and in the diametrical centre of the round projection that is to form the joint. At the point of intersection of these two lines, or in other words where these two lines cross each other, make an indent with a sharp-pointed prick-punch, and there drill a hole of the size that the rivet is to be made.

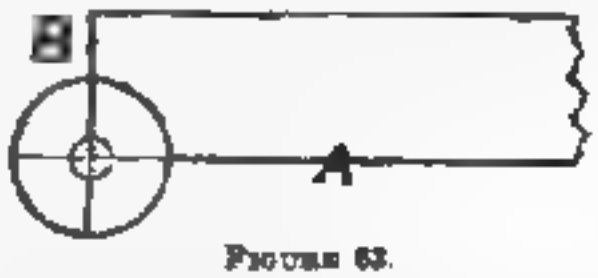


FIGURE 63.

Fig. 64 shows the finished joint ready to receive its mate and be rivetted together. After the hole for the rivet is made, a tool must be used to "sweep" or cut down the surface at C, and also leave a sharp and smooth shoulder as shown at D.

To make this tool, select a piece of steel, centre it in the lathe, and turn one end—say an inch or so—

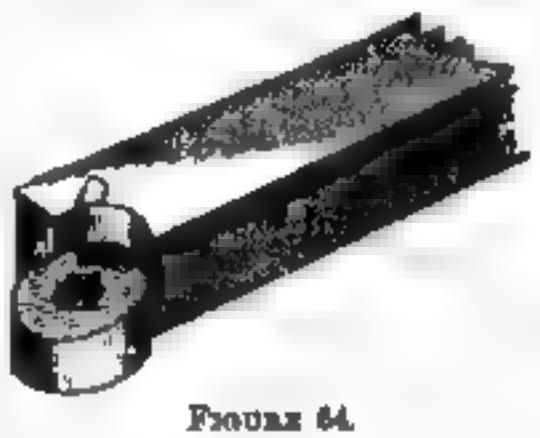


FIGURE 64.

of the same size that the joint is to be. In this end drill a hole lengthwise, but exactly in the centre, of the same size that the rivet is to be. Cut teeth on this end, and temper as any tool for cutting metals. Insert a steel pin in the hole, leaving it

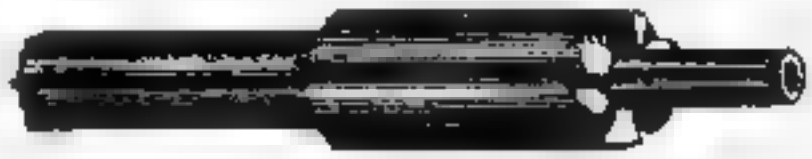


FIGURE 65.

projecting half an inch or more, and the tool is ready for use. The cutting end of the tool is shown in Fig. 65. Of course the other end must be fitted to the lathe chuck or a bit-stock in order to use it. Insert the projecting end of the pin in the hole A, drilled for the joint, and by means of the lathe or bit-stock, cut down each half of the mould to about half of its thickness. The outer circle or cut of the tool will be a guide to which to file the circle of the joint. If the cutting end of the tool be made a little convex it will form the surface of the joint a little hollowing, and a better fit will be the result.

Countersunk the outer ends of the hole, insert the rivet, and rivet them together. The perfection of the joint can be ascertained by opening and closing the mould a few times, removing the surface where the rubbing is apparent, with a fine-cut file.

If the surfaces of the two halves at B, Fig. 64, do not exactly come together, and the material be brass or malleable iron, a few blows with a hammer will insure close contact. It may be necessary to say that the surface at B must first be made true and square, so that the two halves will fit closely, and then "lay out" the joint from this surface.

If there be many bullet moulds to make the circle of, the joints can be made by means of a cutter revolving in the lathe. Make this cutter about two and a half inches in diameter and half an inch thick. Cut teeth in the sides as well as on the circumference. Fit it in a spindle so it will revolve. After the joint is drilled fit it so as to turn on a pin fixed in a piece of iron that is held at one side of the cutter. By feeding the mould up to the cutter the surface or shoulder is cut where the two portions of the joint come in contact when opened. By turning the mould slowly around a portion of the circle is cut, say about one-half. Remove the mould from the pin, invert it, and the remainder of the circle can be cut; the whole "round" and the abutting sur-

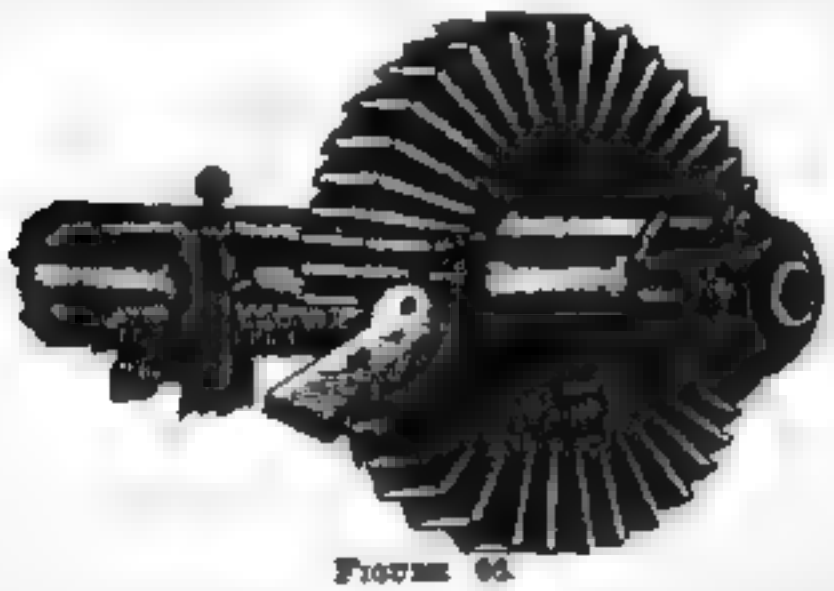


FIGURE 66.

faces being produced at two cuts; a little smoothing up with a file being necessary to finish it. This operation and the cutting is shown in Fig. 66.

How to Make a Ball Cherry.—The term "cherry," as applied to the tool used to make the mould for spherical balls or bullets, was no doubt borrowed from the fruit of the same name—in fact the fruit and tool are very similar in form and size. To any one not conversant with the process of producing a sphere in metal it seems a very difficult operation, but nevertheless it is very simple, and only requires a little knowledge and experience to make a cherry to fit any bore of gun. This is the rule governing the operation: A rotating body is passed through a properly shaped circular aperture in a flat steel die that is held with its upper or cutting in the same plane as the axial line of the body rotating. That's all.

Now, to make application of the rule. Suppose we have a rifle of a certain bore to which is to be fitted a round ball. First, take a piece of steel, we will say about one-quarter of an inch thick, about one inch wide and about six or eight inches long. An old file of good quality, with the temper drawn and the teeth ground away, may answer the purpose. It should be annealed as soft as possible. With a drill make a hole near one end, but a little less in size than the bullet to be produced. With a taper half-round reamer cut out the hole until that side of it which is to be the upper or cutting edge is exactly the size of the bullet desired.

FIGURE 67.

The advantage of using this taper half-round reamer is the hole is made perfectly round, and at the same time the taper of the reamer gives a bevel to the hole that forms a good, strong and effective cutting edge. With a file cut out a portion of the tool of a V shape, bevelling the edges the same as the hole as shown in Fig 67. This V may be either cut on the end, a side of the tool, as shown, but in use it is preferred to be cut on the side, as then, if necessary, the hand can find a hold on that end to assist it in operating. When done, temper for use. For the cherry, turn a piece of steel in the lathe to fit a chuck. Half-inch octagon is perhaps the best size of steel from which to make cherries of less diameter than half-inch, and the length about six inches. The end on which the cherry is to be made is roughly fashioned into a ball, leaving the end where the centre supports it to be removed by the lathe tool or by filing.

When fitted so that the rough blank will be held firmly in the chuck, run the lathe at moderate speed,

FIGURE 68.

set the T rest so that the steel die can be held on it about level with the under side of the rotating blank. On the rest lay the die, and press the opening so as to receive the rough sphere, applying oil and not pressing too hard. Let it gradually scrape its way through the circular aperture, the V-shaped opening in the side receiving the stem to which the cherry is attached. In Fig. 68 is shown the finished blank after being passed through the die. If it be preferred the die may be held in the hands and not supported on the T rest. Take care to supply plenty of oil to the work, as this will prevent scratching or tearing the cherry while being formed. It is well to make two of these holes, one at each end of the piece of steel, roughing the blank with the first, which is a little larger than the one used to finish the cherry of the exact size. When this tool gets dull grind on the upper or cutting edge, but not too much, as it will enlarge the hole, and the result will be to make a larger cherry.

To form these blanks into cutting tools, a copy can be taken from the cherries as sold to the trade. Bear in mind to leave the grooves deep enough to receive the metal cut from the blank mould when in

FIGURE 69.

operation.

It will be observed that the cherries as purchased (Fig. 69) do not have their cutting edges terminate in that portion of the mould, but usually on one side. This is done to insure a perfectly spherical form by having a cutting side operating at the bottom of the hole while it is being formed. It is somewhat difficult to make this form of cutting edge, and some patience and care must be exercised or the blank may be spoiled

Every mechanic knows how nice and rapidly a well-made drill will cut. Suppose this form of cutting edge be applied to the bullet cherry. It is no matter if this cherry be round or of conical form. Fill two cutting edges like a drill on opposite sides of the blank from the shank to the end of the cherry. It is evident that here the two rounded portions that are left on each side of the cutting edges to be removed that the tool is nothing more

FIGURE 70.

nor less than a peculiar shaped drill or reamer that might form an internal sphere. But as this form could not well be applied between the sides of blank bullet moulds, and as the full rounded sides would not permit of these edges cutting, then form the rounded surfaces into similar cutting edges like the two first made, only not so large, making three or

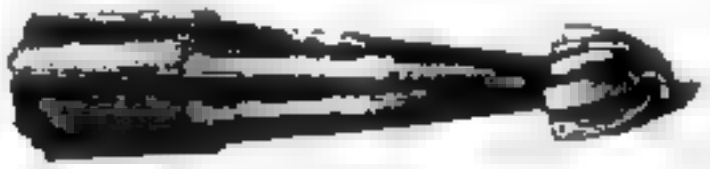


FIGURE 71

four on each side, according to the size of the cherry These cuts can very easily be made with a fine cut three-square or half round file. A cherry of this form for a round ball is shown in Fig. 70, and one for a conical ball in Fig 71.

In using a three-square file, to get a fine cutting edge that will make a sharp V cut, grind away the teeth of one side. This will remove the slightly rounded or blunt edge as usually made on this form of file By grinding thus, two acute cutting angles can be had from one file. If they get a little dull on the sharp cutting corner, a little grinding will restore the edge and make it sharp again.

Tempering Bullet Cherries.—In tempering the cherry do not leave it too hard, and be careful not to temper too hard above the spherical portion. Leave the shank softer, as it will be less liable to break. It is not necessary to shape the shank so as to exactly conform to the shape of the V opening in the forming tool, for, as the edges of this opening have been bevelled the same as the opening that shapes the cherry, they will act as cutters, and will reduce the shank to conform to the V It is well to mark the cherries in some conspicuous place on the shank, with their size in hundredths of an inch, the same as cartridges are numbered, and also mark them with the number of round balls to the pound, as was formerly in vogue among gunsmiths The finished cherries, as purchased from dealers, are so numbered.

Cherries, as purchased, have shanks fitted to be used with a bit-stock, but if the gunsmith fits these tools to be used in a lathe chuck that has a round hole, necessitating a round shank, and also wishes to use them in a bit-stock, he can fill up the square hole in the bit-stock by brazing therein a piece of iron, and then drilling a round hole to fit the tool.

CHAPTER XXVIII.

Screw Making Tools..... ... ...
How to Make Screw Tools.... .. ..
How to Make Small Taps..... ... .

CHAPTER XXVIII.

SCREW-MAKING TOOLS.

THE tools used by the "old time" gunsmith for screw making were few and simple, and are now seldom found except in the shop of some "old veteran" of the trade. Twenty-five or thirty years ago modifications of these tools were used in some of

FIGURE 72.

the armories where Government arms were made, and even now the same principle of these tools is employed but changed in form and adapted to machinery operated by steam or other power.

Fig. 72 shows a tool to be held in the vise by the projection, and the rough form of the screw, or a piece of wire of suitable size is inserted in the hole in the centre of the raised portion, cut with radial teeth, and a screwdriver inserted in a transverse slot in the other end of the rough screw, or bit of rod; it is then rotated by a bit stock until by the pressure applied the teeth cut away the metal and so forms the body of the screw. To form the head of the screw another tool, shown in Fig. 73 having a countersunk hole made in the centre of the diameter of the head but a little deeper, is used. The unenlarged

FIGURE 73.

portion of the hole in the tool corresponding to the

body of the screw, which being inserted in the hole is rotated by means of the screwdriver in the bit stock, until the head is shaped in the same manner

FIGURE 74.

that the body was formed. Of course, different tools had to be made for different sized screws.

In forming the tang screw, which has the head bevelled on the under side, a tool was used like Fig 74. The rod was turned into a tool in the same manner as for making a flat headed screw; then the body was inserted in the bevelled head-making tool and rotated as for making a flat head. The edges of the bevelled teeth being so formed as to become cutters upon the inner or central edges, and so reduce the screw head to that shape.

For countersinking, to let in the heads of these bevelled forms of screws, a tool is used like the one as shown in Fig. 75—the stem serving as a guide

FIGURE 75.

when inserted in the work, and a slot to admit the screw driver, for turning them, being made in the large end. This tool is made about two inches in length, the head being about half an inch in diameter

The length of the tools in Figs. 72, 73 and 74, where they are held in the vise, is about an inch and a half or an inch and three-quarters; the width from half an inch to five-eighths, according to size; the thickness one-quarter inch. The round part with the cutting teeth is about three-quarters of an inch in height from the flat portion, and is about the same diameter. The teeth may be in number five, six or eight, as most convenient to make. The tools for bevelled heads are best made with five teeth.

Making Small Taps.—The best manner of making large taps is to turn them to size in a lathe, and then cut the screw by the same means of with a die plate. Small taps cannot very well be so made. A very good way is to get good steel wire—generally sold of all sizes, under the name of Stubs' steel wire—and from this make taps; the thread can be cut by means of a die stock.

When the thread is properly made, there are several ways to form it so as to make it a cutting tool. One method is to file it with four sides, making it a square. In this case it scarcely cuts, but rather "jams" up a thread. Another one is to file it triangular or "three square." This form makes it rather a better form, as regards cutting quality; but as in case of the square form, it will be observed that the inclination of the sides is such that they would not be selected for a cutting tool if such an angle were made as a tool for that purpose. If two flutes or grooves be made of angular form, with a square file, or two hollows be cut with a round file, these flutes running lengthwise with the tool, the edges then present more of the aspect of a cutting tool; but the distance is so great between the flutes that there is great friction, and breakage will result if the hole to be tapped be too small, or too much force be applied. If three or four flutes be made the evil of friction will then be remedied Be sure to cut the flutes deep enough to receive all cuttings that may be removed or the tap will become clogged, and can with difficulty be turned out, or perhaps may be broken.

A cheap and good way to finish a tap is, after the thread is made, to file away one half of its diameter nearly the length of the thread. This will give great clearance and space for the cuttings, and at the same time the cutting edge is very sharp and is strong. It will be found to cut very easily. If a tap of this make becomes dull it can be sharpened by grinding on the flat formed by filing it away. If the tap be too large it can be made smaller by thus grinding.

Large taps work equally well made in this way, but care must be taken in starting them in a hole or the thread may be made crooked.

Reamers, both large and small, straight or taper, can be made in this manner, and are effective as well as cheap to make, and can be kept sharp by grinding them on the flat side.

CHAPTER XXIX.

NOMENCLATURE.....
Nomenclature of the Gun Stock. .....
Nomenclature of the Gun Lock.. .....
Nomenclature of the Hammer ... .
Nomenclature of the Lock Plate. .....
Nomenclature of the Tumbler... ....
Nomenclature of the Bridle..... .....
Nomenclature of the Main Spring ....
Nomenclature of the Sear.. ....
Nomenclature of the Sear Spring ....
Nomenclature of the Swivel ..... - - .. ..
Nomenclature of the Breech Pin. ....
Nomenclature of the Screws ....

CHAPTER XXIX.

Nomenclature of the Gun Stock.—Fig. 76 shows a gun stock with the locks, plates and other metal portions removed. *a*, is the butt; *b*, the small or handle; *c*, the head; *d*, the bump; *e*, the comb; *f*,

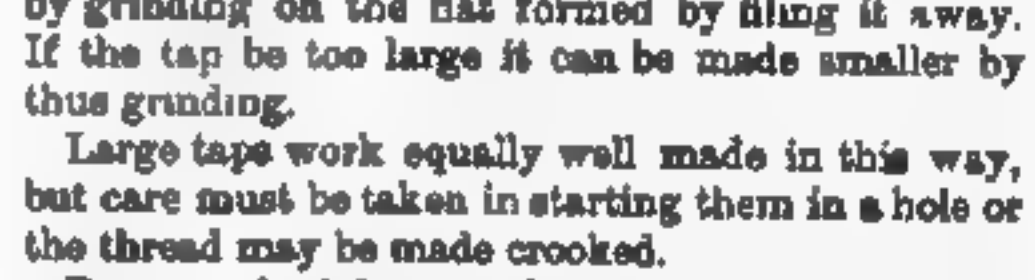


FIGURE 76.

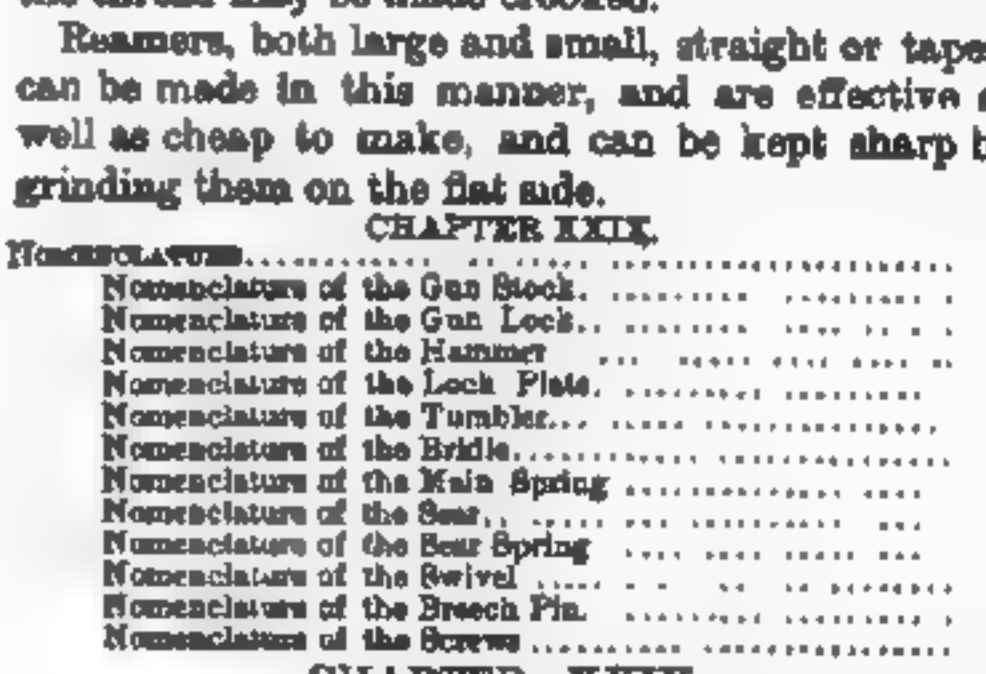


FIGURE 77.

the toe; *g*, lock-bed; *h*, fore-end or fore-arm; *i*, pistol-grip; *k*, cap or end of pistol-grip; *l*, tip of fore-end; *m*, escutcheons; *n*, mortice for bolt; *o*, chequering.

Nomenclature of the Gun Lock.—The number of pieces in a common gun lock, as shown, are thirteen, and are fully illustrated in the cut, Fig. 77. *A*, is the lock-plate; *B*, the hammer;

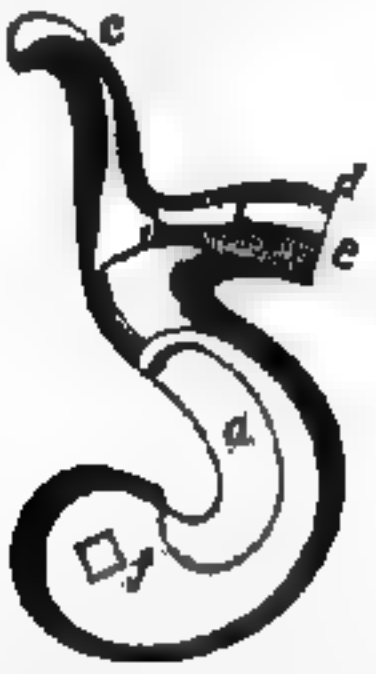


FIGURE 77.

FIGURE 76.

C, mainspring; *D*, the bridle; *E*, the tumbler; *F*, the sear; *G*, the sear-spring; *H*, the swivel or stirrup; *I*, the sear-spring screw; *K*, *K*, *K*, the bridle screws; *L*, hole for side-screw. In some locks there are only two bridle screws. In others a screw holds the mainspring to place instead of a lip catching under the stud.

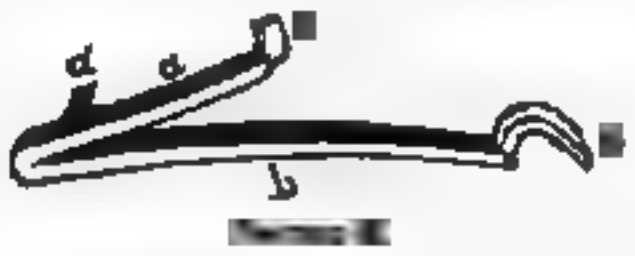
Nomenclature of the Hammer.—The names of different parts of the hammer, Fig. 78, are: *a*, the body;

FIGURE 78.

FIGURE 81.

b, the head; *c*, the comb; *d*, the nose; *e*, the cup; *f*, tumbler-hole.

Nomenclature of the Lock-Plate.—The names of different portions of the lock-plate, Fig. 79, are: *a*,



the bolster; *b*, mainspring-catch; *c*, hole for mainspring-pivot, *d*, hole for side-screw; *e*, hole for arbor

FIGURE 83.

FIGURE 84.

of tumbler; *f*, hole for sear-screw; *g*, hole for sear spring-screw; *h*, slot for sear-spring stud; *i*, *i*, holes

Nomenclature of the Tumbler.—The names of the tumbler, Fig. 80, are: *a*, the body; *b*, arbor; *c*, squares; *d*, pivot; *e*, swivel-arm; *f*, pin-hole, and *g*, the tumbler-screw hole.

Nomenclature of the Bridle.—The bridle, Fig. 81, consists of: *a*, the body; *b*, the eye for tumbler-pivot; *c*, hole for sear-screw; *d*, *d*, holes for bridle screws. Some tumblers have a pin that goes in a hole in the lock-plate, and this pin is called a pivot.

FIG 85.

Nomenclature of the Mainspring.—The mainspring, Fig. 82, consists of: *a*, the upper branch; *b*, the lower branch; *c*, the hook; *d*, the pivot; *e*, the catch which is sometimes called the tang.

Nomenclature of the Sear.—The sear, Fig. 83, con-

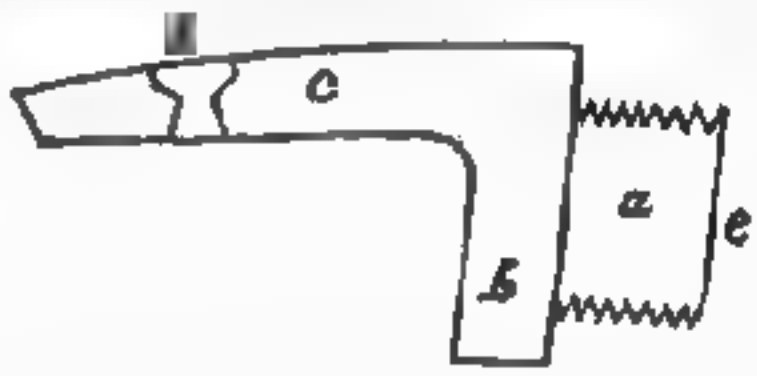


FIGURE 82.

sists of: *a*, the body; *b*, the nose; *c*, the arm; *d*, screw-hole.

Nomenclature of the Sear-Spring.—The sear-spring, Fig. 84, consists of: *a*, the blade; *b*, upper branch; *c*, lower branch; *d*, the stud; *e*, screw-hole.

Nomenclature of the Swivel.—The mainspring-swivel or stirrup, Fig. 85, consists of: *a*, the body; *b*, the axis; and *c*, the tumbler-pin hole.

Nomenclature of the Breech-Pin.—Fig. 86 shows full size of musket-barrel breech-pin. *a*, plug with threads; *b*, tenon; *c*, tang; *d*, tang-screw hole; *e*, face.

In sporting guns the tang is often called the "strap," and is distinguished as long and short. The length varying from two and a half inches as shortest, and five inches as the longest. Sometimes the term "tail" is employed instead of tang or strap. The diameter of the plug is generally one-half, five-eighths, and three-quarters of an inch. The diameter of the pin used in United States muskets and rifles is three-quarters of an inch.

Nomenclature of Screws.—In all the screws, the parts are the stem, the head, the slot and the thread.

CHAPTER XXX.

On Browning.....
Objects of Browning
Preparatory [redacted]
The Process of Browning
Browning Damascus Barrels.
Browning Belgian Damascus Barrels
Browning Inferior Barrels
Plain Welded Barrels Made to Resemble Twist.
Smoke Staining.....

CHAPTER XXX.

ON BROWNING.

Object of Browning.—Browning is done for the purpose of subduing the bright color of the barrel

from the sight of game; to bring out the fibres of the metal to show their form and beauty, and also to show whether the metal be free from flaws. It does not prevent barrels from rusting, but rust will not attack so readily as if left in a bright condition. The browning is very certain to make all defects appear, except those designedly hidden, and not only defects of materials but the filing and finishing of the barrel, if not well done, will appear in marks in certain lights. A thoroughly well-filed barrel presents, what may be called, a deep liquid appearance.

Preparatory Process.—The process of browning is simple and cheap, and at the same time serves to protect a gun, in some measure, from rust, and also adds to its appearance. The operation consists in producing a very thin uniform film of rust, or oxide, upon the iron and giving a gloss to its surface by rubbing wax over it, or by coating it with some kind of varnish, as shellac varnish.

Preparatory to browning, the barrel having been filed and polished bright, is rubbed with lime to remove all grease. Some gun makers use wet lime or lime water and then rub in dry powdered lime. The vent holes are to be stopped with wax or wooden plugs, and both breech and muzzle are to be plugged with wooden rods which serve as handles to hold the barrel during the operation. The object of plugging is to prevent the mixture from finding its way into the interior of the barrel and the breech and muzzle plugs also serving as handles, prevent the hands from coming in contact with the barrel, which would prevent the stain from "taking," and consequently cause a spot of different color from that on other portions of the work. The solution is generally applied with a sponge or cloth, sponge being preferable, until the surface is equally moistened, and after standing in a warm place, generally about twenty-four hours, it is rubbed off with a stiff brush or a wire card. The state of the atmosphere will have much to do with the action of the browning mixture. It can be easily ascertained when the barrels are dry enough to work, as by applying the card, if dry, the rust will fly off quickly, but if not dry, the rust will adhere firmly and the surface of the barrel will look streaky. Some mixtures will dry in twelve hours or even less, but twenty-four hours will insure their being perfectly dry. The process of wetting and brushing, or "carding," is repeated until the barrel has acquired the desired color. When this stage is reached the barrel is freely washed with hot water, in which a little potash may be mixed. Then wash with clean water and dry thoroughly. A little lime water may be used as a wash to destroy any free acid that may remain in the pores of the metal.

The Processes of Browning.—A browning or rust may be obtained very speedily and well by enclosing the barrels in a chamber and subjecting them to the vapor of muriatic acid. The same end may be obtained by moistening the surface with dilute muriatic or nitric acid. There is another material sometimes used, which is butter or chloride of antimony It is sometimes called "bronzing or browning salt." In using this substance, a uniform mixture is made with it and olive oil; this is rubbed upon the barrel, which is slightly heated, and is then exposed to the air until the required degree of browning is arrived at. The operation of the antimony is quickened by rubbing on after it, a little aquafortis.

Browning Damascus Barrels.—Damascus barrels are browned by first burnishing the barrels very nicely, then cover with bone oil; pound, or drop, or strew wood ashes all over, then heat in a wire cage filled with charcoal, until the first dark blue is obtained. After the barrels are cold, mix a small quantity of sulphuric acid in water, and with a hard brush apply to the barrel. The acid will remove the color from the steel portion of the barrel, leaving the iron, on account of its greater adhesion, still retaining its blue color. Take care to keep a good color and not extract too much.

Browning Belgian Damascus Barrels.—The characteristic, bright, wavy appearance of Belgian Damascus barrels is generally "eat up," and the process is termed "pickling." The process results in eating away the softer metals from the hanker, used in forming the barrel. The preparation used is one pound of blue vitriol dissolved in a gallon of soft water, at the boiling point, and the boiling continued until the quantity is reduced about one-fourth; then let it cool, and pour out into a lead trough. Plug the barrels securely at both breech and muzzle, so that the liquid cannot get into the interior. When the barrels are immersed in the solution, it will act upon the metal in fifteen to twenty minutes. Remove and wash with water, and if not satisfactory, immerse again, until the operation is complete. Pour boiling water over them, and scratch well with a steel brush or card, which will eventually give the beautiful, bright, wavy appearance. Laminated steel barrels may be subjected to this same opera-

Browning Inferior Barrels.—Inferior quality of Birmingham barrels are browned as follows: Dissolve as much muriate of mercury as can be taken up in a glassfull of alcohol. Mix this solution in one pint or more of water. A small quantity of this mixture is poured on a little whitening and laid on the barrel with a sponge, rather lightly. As soon as dry, brush off and lay on a fresh coating. So proceed until the barrel is dark enough, which is generally about two or three days. The effect is to make the softer portions of the metal a beautiful brown, while the harder portions remain quite light. The rusting process is killed by washing in hot water, after which the barrels are suddenly immersed in cold water. This has the effect of heightening the brightness of both colors.

Plain Welded Barrels made to Resemble Twist.—Plain welded barrels are made to resemble twist barrels by wetting a thread or fine cord with dilute acid, and winding it around the barrel so as to make spiral lines, running all along its surface. Wherever the thread touches a slight coating of rust will be formed. The barrel may be treated in this way two or three times, and the spiral windings of the thread

will exhibit fine dark lines closely resembling twist barrels. To wind the thread the barrel may be put between the centres of a lathe, and so turned while it winds the thread upon it, being guided by the hand, or the barrel may be supported between centres or put on a rod of wood, which may be turned by a crank or handle.

Barrels may be colored by exposing them to a degree of heat sufficient to produce a blue tinge, and is done to color pistol barrels, but when double gun barrels are soft soldered together this cannot be done on account of danger of melting the solder. The inner surface of the barrel, which is also so colored, must be polished after the operation

Smoke Staining.—This method of coloring barrels is as follows: The barrels are washed with a little sulphuric acid, to cause the metal to receive the effects of the gas more readily; it is then washed off, and the barrels rubbed dry. A fire is built with coal possessing as much hydrogen gas and as little sulphur as possible. Burn the coals until they give a clear, white flame, with no black smoke. Pass the barrels through that flame, backward and forward, until the whole are covered with a black, sooty coating. Place them in a damp, cool cellar and let them stand about twenty-four hours, and if the place be sufficiently damp, the iron parts will be covered with a red rust, while the steel portions still retain the sooty coat. Scratch them off with a wire card and rub with a piece of cloth, and wash or polish with water, using on the cloth a little flour of emery. The steel will be found to be of the original bright color, while the iron will be a little darker. Rub dry, and pass the barrels through the flame again. Allow them to stand about twelve hours to rust, and then polish as before. With every smoking the colors will be a little darker. The darkest color to be obtained is a fine purple-black color on the iron; the steel inclining to a copper color.

The principle of this stain is simply the hydrogen gas contained in the coal acting on the iron, iron being of a softer nature than the steel, which it does not affect, the flame also possessing a quantity of tar, it is imperceptibly embodied by the iron during the action of the oxide, and, when finished, by filling up the spaces created, it becomes decidedly more impervious to damp or wet than any other stain or browning which is composed entirely of oxide of iron.

CHAPTER XXXI.

Recipes for Browning ....
Thirteen Recipes for Plain Barrels.....
Four Recipes for Twist Barrels.....
To Blue Gun Barrels.....
Brown Tint for Iron or Steel .....
Transparent Blue for Iron or Steel.....
Varnish for Browned Barrels, Three Recipes.....
Finish for Browned Barrels.....
To Remove Old Browning.....

CHAPTER XXXI.

RECIPES FOR BROWNING GUN BARRELS.

Solution for Browning Gun Barrels.—Make a solution by putting together in a glass vessel, spirits of nitre, three-quarter ounce; tincture of steel, three-quarter ounce; black brimstone, one-quarter ounce; blue vitriol, one-half ounce; corrosive sublimate, one-quarter ounce; nitric acid, one drachm, and copperas, one-quarter ounce. Mix with one and one half pints of rain water, and bottle for use. Clean the barrel till entirely bright, rubbing it over with finest emery paper, then apply the solution with a clean white cloth. Set away for twenty-four hours. At the end of this time a rust will have formed over the barrel. Go over it with a steel scratch-brush, then rub off all the rust with a woolen cloth. If you find the brown not dark enough, cover again with the solution and set away twenty-four hours longer. Remove the rust exactly as in the first instance, then, the color suiting, wash off with a wet cloth, rub to thorough dryness, and finish by rubbing with linseed oil, to prevent further rusting.

This application browns the barrel beautifully, and in case of twist leaves the markings prominently plain.

The tincture of steel is sometimes not to be obtained at a small drug store, in which case the unmedicated tincture of iron may be made to answer reasonably well.

2. Sulphate of copper, one ounce; sweet spirits of nitre, one ounce; water, one pint. Mix. In a few days it will be ready for use.

3. Tincture muriate of iron, one ounce; nitric ether, one ounce; sulphate of copper, four scruples, rain water, one pint; if the process is to be hurried, add two or three grains of oxymuriate of mercury. Put in lime water to neutralize acid.

4. Spirits of nitre, one pound; alcohol, one pound; corrosive sublimate, one ounce. Mix and cork for use.

5. Tincture of muriate of iron, one ounce; nitric ether, one ounce; sulphate of copper, four scruples, rain water, one pint.

6. Alcohol, one and a half ounce; tincture of steel, one and a half ounce; corrosive sublimate, one and a half ounce; sweet spirits of nitre, one and a half ounce; blue vitriol, one ounce; nitric acid, three-quarters of an ounce. Mix and dissolve in one quart of warm water. Keep in glass bottles.

7. Nitric ether, six ounces; alcohol, one ounce; sulphate of copper (blue vitriol), one and a half ounce; muriated tincture of iron, one and a half ounce; tincture of gum benzoin, one and a half ounce. Dissolve the sulphate of copper in water, add the other ingredients, previously mixed, and then add three pints of boiling water.

8. Spirits of nitre, one pound; alcohol, one pound; corrosive sublimate, one ounce Mix in a bottle and keep corked for use.

9. Soft water, one quart; dissolve in it blue vitriol, two ounces; corrosive sublimate, one ounce; and one ounce of spirits of nitre. Put on one coating, and in about an hour a second one, then let the work stand twelve hours. Oil and rub with cloth.

10. One ounce nitric acid, one ounce blue vitriol; dissolve in four ounces rain water, and mix all

together in a pint of water. Warm the mixture slightly and apply gently with a sponge.

11 Nitric acid, one half ounce; sweet spirits of nitre, one half ounce; alcohol, one ounce; blue vitriol, two ounces; tincture of iron, one ounce; soft water, one quart.

12. Sweet spirits of nitre, one and a half ounce; nitric acid, one ounce; tincture of steel, two ounces; alcohol, one and a half ounce; blue vitriol, one half ounce. Dissolve the blue vitriol in cold rain water, and add the other ingredients to make one quart.

13. Apply the following fluid by means of a clean white cloth: Spirits of nitre, one pound; alcohol, one pound; corrosive sublimate, one ounce. Mix in a bottle and keep corked for use. Apply one coat and set in a warm, dark place, until a red rust is formed over the whole surface, which will require, in warm weather, from ten to twelve hours; in cold, from fifteen to twenty hours. Then card it down with a gun-maker's card, and rub off with a clean cloth. Repeat the process until the color suits, as each coat gives a darker shade.

Browning Recipes for Twist and Laminated Barrels.—1. Sweet spirits of nitre, one-half ounce; tincture of steel, one-quarter ounce; corrosive sublimate, one-half ounce; aqua fortis, sixty drops; nitrate of silver, four grains; a small lump of chalk and one pint of rain water.

2. Tincture of sesqui-chloride of iron, one-half ounce; corrosive sublimate, one drachm; sulphate of copper, one-half drachm; nitric acid, one drachm to one and a half drachms; alcohol, six drachms; water, eight ounces. Dissolve the corrosive sublimate in the alcohol, then add the solution to the other ingredients and let the whole stand for a month or six weeks, when it will be ready for use

3. Sweet spirits of nitre, one ounce; tincture of steel, one-half ounce; blue vitriol, one-quarter ounce; nitric acid, six drops; corrosive sublimate, fourteen grains; water, one pint. When the barrels are dark enough, drop a few drops of muriatic acid in water and wash the barrel slightly to brighten the twists.

4. Muriatic tincture of steel, one ounce; alcohol, one ounce; muriate of mercury, one-quarter ounce; strong nitric acid, one-quarter ounce; blue vitriol, one-eighth ounce; water, one quart. Thoroughly mix the ingredients. Let them stand about thirty days before using. Wet the barrels with the mixture, applied with a sponge, about once every two hours. Scratch off with wire card every morning until the barrels are dark enough

To Blue Gun Barrels.—A very pretty bluish color may be imparted to gun barrels by dressing them off to brightness with fine emery paper, and then rubbing them over quickly with nitric acid. When the desired color has appeared, wash them off with clean water, rub dry with a soft cloth, and then rub with linseed oil to prevent any further action of the acid.

Brown Tint for Iron or Steel.—Dissolve, in four parts water, two parts of crystalized chloride of iron; two parts of chloride of antimony; and one part of gallic acid, and apply the solution with a sponge or cloth to the barrel, letting it dry in a warm place. Repeat the process according to the depth of color desired. Wash with warm water, and dry; then rub over with boiled linseed oil. The metal receives a brown tint and resists moisture. The chloride of antimony should be as little acid as possible.

Transparent Blue for Iron or Steel.—Put together Demar varnish, one quart; fine ground Prussian blue, one-quarter ounce. Polish the metal to brightness, and put on thinly with a varnish brush. A beautiful transparent blue color, but one that will not stand rough usage.

Varnish for Browned Barrels.—1. Dissolve ten parts clear grains of mastic, five parts camphor, fifteen grains sandarac, and five parts elemi, in a sufficient quantity of alcohol, and apply the varnish without heat. The articles treated with this varnish will not only be preserved from rust, but their metallic lustre will not be in the least dimmed by exposure to dampness.

2. Another varnish may be made by using gum shellac, one ounce; gum sandarac, one ounce; Venice turpentine, one drachm; and ninety-eight per cent. alcohol, one gallon.

3. Another formula consists of shellac, one ounce; dragon's blood, one-quarter of an ounce; alcohol, one quart. A little less dragon's blood may be used if the color be too great.

Finish for Browned Barrels.—There are many ways of finishing barrels after browning. Some gunsmiths warm the barrels and rub them while quite warm with a flannel cloth and finish with a little bees-wax and turpentine. Some polish with a steel burnisher or rub with white wax; others use a wash of thin shellac varnish laid on carefully and evenly with a camel's hair brush. Some finish off with a solution of two ounces of shellac and three drachms of dragon's blood dissolved in two quarts of good alcohol.

To Remove Old Browning.—To remove old browning, plug the vent and muzzle of the barrels; immerse the browned parts, for about one hour, in hot lime water, or strong lye, to remove the varnish or grease; wipe them and put them in vinegar, in a wooden trough, for an hour or less, when the browning may be wiped off with a rag.

CHAPTER XXXII.

MISCELLANEOUS.....
Shellac and Its Uses.....
How to Make Shellac Varnish.....
How to Conceal Bad Places in Wood.....
Another Method.....
Emery Cloth and Emery Paper.....
Uses of the Alcohol Lamp.....
How to Make Small Springs.....
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Advantages of the Alcohol Lamp.....
The Soldering Copper.....
How to Heat the Copper.....
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To Prevent Gun Barrels from Glimmering.....
Repairing Shot Chargers.....
Broken Plunger Nipples.....
How to Remove Rusted Screws, Nipples, etc.....
Patent Breech, Bursted.....
Broken Tumblers.....
Describing Lines on Bright Surfaces.....

CHAPTER XXXII.

MISCELLANEOUS.

Shellac and its Uses. Gum shellac is the gunsmith's friend. It is the best material from which to make the varnish he uses, and in wood-working, if there be cracks or checks in the material, or in stocking should a little slip of the tool occur while letting in locks or other parts, a little of the gum judiciously applied remedies the defect, and, like charity, "covers a multitude of little sins."

Shellac is often adulterated with resins, and it requires some knowledge of the article to detect this adulteration. It can only be ascertained by experience in handling, or by ocular demonstration with an expert.

To make Shellac Varnish.—To make varnish, put the shellac in a clean vessel and put over it a quantity of good alcohol, enough to about cover it, if it be somewhat compact in the receptacle; if too thick when made it can be thinned with alcohol. While the gum is dissolving keep it covered from dust and let it stand in a warm place, as in the sun during the summer, or near a warm stove in the winter. Too much warmth will tend to evaporate the alcohol; and for this reason it ought to be somewhat sealed from the air. It may take two or three days to thoroughly dissolve the gum for varnish, according to the temperature in which it is placed, etc.

When the gum is dissolved, thin with alcohol to the proper consistency for easy application with the brush. If it be dirty, or it be desired to have it clear and nice, filter it through good blotting paper. When not using the varnish, keep close covered to prevent evaporation.

How to conceal Bad Places in Wood work.—If there be cracks in a stock or a bad cut made in stocking, as will sometimes happen where locks and straps are let in, apply a piece of the gum to the place and with a warm iron melt it into the place, so that it will be well filled; also warm the wood in close proximity to be sure of good ahesion. Let it remain until cold and solid, and then finish down the same as the stock is finished down

Another Method.—Another method of filling bad places in wood-work is to get fine dust, as made with a fine rasp or file, and mix this dust with thin glue, and rub it into the interstices, letting it remain until hard and solid, and then finish same as the adjoining wood. Neither this nor shellac will adhere where there is oil, or where the surface to adhere has been oiled.

Emery Cloth and Emery Paper.—Emery paper is the cheaper, but is not so durable as the cloth. The paper is soon worn out and is torn in using, but the cloth is seldom destroyed, and can be used so long as any abrasive material remains upon it.

There are about six grades, say Nos. 00, 0, 1, 1½, 2 and 3 which may be selected. To use on plain surfaces cut the sheet up in small, convenient pieces, fold a piece around a file and use as if using the file. In using a finer number, be careful to remove all the marks left by using the previous number. If moistened with oil, a fine, soft-appearing, dead finish is obtained. To use in a lathe, run the work with fast speed and hold the cloth to place with the hand, or put it around a file and so hold it. After the pieces are somewhat worn, they can be used to finish with.

In selecting by the numbers remember that 00 is the finest, and is called flour of emery cloth, or paper; 0 is a little coarser, and then follow the different grades in numerical order.

Uses of the Alcoholic Lamp. How to make Small Springs.—An alcohol lamp is almost indispensable to the jobbing gunsmith. Suppose a small bent spring is to be made, a little trigger spring, for instance, such as is used in many kinds of revolvers, it can be easily formed in this manner: Take a bit of old watch-spring, heat it in the lamp until it is blue, then, with the snips or hand-shears, divide it lengthwise to the necessary width; heat in the flame of the lamp, and with a pair of pliers, bend to the required shape. It is not always necessary to temper these springs, but if it be necessary to do so, heat until red in lamp, using a blow-pipe if the heat be insufficient, harden in oil, and then draw the temper to suit. The whole operation can be done without moving from the bench, and much quicker, and certainly better, than could be done at the forge.

How to make Small Drills.—Then, again, to make small drills of steel wire, use the lamp for heating and tempering. If a small drill be broken, draw the temper in the lamp preparatory to forming it anew. Drills of larger size may be hardened in the forge fire, brightened by grinding or rubbing on a piece of fine emery cloth, and the temper readily drawn in the lamp. The same process may be applied to tempering small screw taps. Small screws can be readily blued in the same manner.

Advantages of the Alcohol Lamp.—The lamp has this advantage over the forge-fire; it draws the temper very evenly, and the temper color can be readily seen, as the flame of alcohol makes no smoke to obscure it. Even for small tempering, when once employed, no gunsmith will think of discontinuing its use.

The Soldering Copper.—The soldering copper for the use of the gunsmith should be about one and a half pounds in weight. The length of the copper should be about four or five inches, of octagon form, with a square pyramidal shaped point. It is fixed to an iron rod about eight inches long, on the end of which is a wooden handle.

How to Heat the Copper.—When heating the copper for use, the best way to ascertain the proper heat is to hold it near the face, and if a bright warm glow is felt, it is hot enough for use. If heated too hot the tinning will be burned off, and it will not work satisfactorily. To replace the tinning, heat it warm enough to just melt the solder, and file the surface to be tinned bright and smooth, then place a little solder and a bit of resin on a piece of sheet-tin, and in this rub the heated copper until the brightened surface has received a coating of the solder, the resin acting as a flux during the operation.

How to Tin the Copper.—Another method to tin a copper is to put the solder and the resin on a brick,

heat the copper and rub until it receives the tin coating. The common soldering acid may be used instead of the resin for a flux. During the operation the point of the copper may be dipped in the acid to facilitate the tinning. It will be found that a too free use of the acid, if used as a flux, for general work, will soon destroy the point of the copper. When this is the case file off the roughness and heat the copper quite warm, and draw it out to shape on the anvil, the same as if working a piece of iron. When so shaped, file smooth and re-tin as directed.

To Prevent Gun Barrels from Glimmering.—It sometimes happens that gun-barrels are disposed to throw off a kind of glimmer without any apparent cause, thus seriously interfering with the hunter or sportsman in getting a correct sight. Of course, the gunsmith would remedy the evil by browning the barrel, but the sportsman in the woods could not do this. Had his friend, the gunsmith, known that such a thing was going to happen he would have told him to get a green hazel-nut pod, crush it, and rub the juice over the barrel, which would produce a beautiful non-glimmering brown. If a green hazel-nut pod could not be had, a green wild plum or a green wild crab-apple or a bunch of green wild grapes would answer the same purpose reasonably well. In the absence of these an unripe black-walnut crushed and rubbed over the barrel would stop the glimmering; and early in spring, when no kind of fruits had yet appeared, a young sprout of wild grape-vine crushed and rubbed over the barrel would make a very good substitute. These were the means resorted to by the "hunters of Kentucky" in the long-gone days of backwoods life, when "Old Kentuck" was young.

Repairing Shot-Chargers.—Very often the stud that holds the lever of a shot-charger will become loose or be forced from its position. The best method to repair it is to remove the lever with its spring and the cutters, put the stud back in place, wet the joint on the inside the charger with soldering acid, and, holding it with the stud downwards, put a bit of soft solder upon the joint, and hold it over an alcohol lamp until the solder melts. If well done it will "stay put."

Sometimes the lever spring will not remain in place, but will slip out. To remedy the evil, take a common Berdan cartridge primer, or any other kind will do, only take one that has been used or has had the priming removed, put inside it a drop of soldering acid and a bit of solder, enough to fill it when melted. Hold it over the lamp until the solder fuses. When it has cooled, wet the charger with a touch of the acid just where the bend of the spring comes, and there place the primer with the solder next the wet place. Hold it in position with a bent piece of wire or a strip of steel bent like a loop. Hold over the lamp, with the primer downward, until the solder is melted. Replace the spring, and it will be found that it will remain firmly in its place.

Broken Plunger Nipples.—When plunger nipples are broken or are lost from the gun, and none are at hand to repair the damage, a substitute may be found in a common gun nipple by filing away a portion of the cone where the cap is placed. It is worth while to save broken nipples, as they are taken from guns with this end in view for their use. They can be annealed or the temper drawn, and they can be kept ready for drilling for the strikers and cutting over to fit the gun in which they are to be inserted. The nipple used in military arms makes a good substitute for a broken plunger nipple, as the thread is nearly the same as that of some plunger nipples.

How to Remove Rusted Screws, Broken Nipples, etc.—Sometimes it so happens that a screw is so rusted in a lock or other part of a gun, or a rusted nipple refuses to start from its seat, and by repeated trials the sides of the screw-head adjoining the slot are worn away or the squares of the nipple are forced off, and the removal of either screw or nipple an almost impossibility with the hand screw driver or nipple wrench. In such cases have a screw-driver or the nipple wrench fitted to the lathe chuck, and, holding the screw or nipple in place to be thus turned out, move the dead spindle of the lathe so that the work be firmly held in place, with no chance to "give back," then turn the lathe by moving the fly-wheel with the hand, or hold the wheel fast and turn the work, and, as there is no chance for the tool to slip from its place, the screw and nipple is almost sure to be started. If so, it may be readily turned from its place by hand.

Converting Muskets to Sporting Guns.—Very often old muskets are brought to the gunsmith to have the rifling bored out and changed so as to present more of the appearance of a sporting gun. If properly worked over they make a gun not very bad-looking, but very serviceable, as they will stand a great amount of abuse and will bear large charges. For shooting hawks and keeping corn-fields clear of depredators they are "just the thing."

After the rifling is removed, cut off the barrel to 30 or 32 inches in length. Take off the bands and throw them away. Cut off the stock where the top of the lower band comes, solder a rib on under side of the barrel and attach two thimbles to receive a wooden ramrod. Bore out the stock to receive the wooden rod, using the thimbles on the rib as guides in so doing. Fit the rod as in sporting guns. Cast a tip on fore end of stock where the lower band was, using the lower shoulder where the band rested for the shoulder of the tip. Remove the elevating sight by heating, if it be soldered on, and fix muzzle sight by soldering on a bit of brass, or by drilling a hole and putting in a pin and filing to shape.

In boring for the rod the bit may strike the forward lock screw, and when this be the case float the stock so that the rod will go above the screw. Don't attempt to change the shape of the stock by removing any portion of it, otherwise than stated, for by so doing the shape and symmetry will be lost, and it will show to be a botch job.

To hold the barrel in place a loop for either wire or bolt must be attached to the barrel a little dis-

tance back from the fore end, and a wire or bolt put through the stock the same as other guns are made. In place of the wire or bolt a very good plan is to put a short stud on the barrel, and from the under side of the fore end put in a screw with a large head, like a tumbler-screw. In this case it is necessary to drill a hole through the stud to let the ramrod pass through.

Patent Breech, Bursted.—As the right-hand barrel of double muzzle-loading guns is fired more than the other, it sometimes happens that the patent breech of this barrel is destroyed or becomes defective. It can be replaced by taking a piece of good sound iron, cut down one end of it, and cut a thread the same as if making a breech-pin. After being fitted to the barrel cup it for powder-chamber like the one removed, and cut the hook end off to length. Make the nipple seat as given in the article on that subject. File the hook so as to fit the break-off, remove from the gun, and case-harden. A somewhat formidable-looking job to the one who never made one, but very easy and simple when once accomplished

Broken Tumblers.—It often happens that the tumbler in a lock is broken off where the hammer goes on, and no tumbler is at hand to replace it. A repair may be made by filing away the broken square and filing a groove or slot down the round part where it went through the lock plate. Fit a piece of square iron or steel, of the size of the broken square, or a round piece that will make the square, to the tumbler by filing away one end to fit the slot filed in the round part. Hold it in place with a piece of binding wire twisted around it, and braze it with spelter solder or good soft copper or brass, then finish to fit the hammer.

Another way is to remove the end where it goes into the bridle and then drill a hole through the tumbler of the size of the end or bearing; make the piece to be brazed on with one end to fit this hole and put it through far enough to make the end filed away. When fitted, braze and finish.

When the trigger catch of a tumbler is broken or is worn away, it can be entirely removed by filing and a piece of steel fitted or held by a small rivet and then brazed. After being finished up and fitted to the trigger, the tumbler can be hardened, care being taken not to heat it sufficiently to melt the brazing material.

Describing Lines on Bright Surfaces.—Many gunsmiths find it difficult to make the pattern of work upon iron or steel, especially after the surface is finished. Yet it is necessary to have the outline of the intended form. For instance, if the pattern of a hammer for a revolver or a gun hammer, the sides of which are both flat (in fact the hammers of many breech-loading rifles are made in this manner), be required to be made on a piece of iron or steel that has been faced down, the method is to drill a hole for the screw or pin on which it turns, then fasten the pattern to the work by driving a piece of wire into the hole, and, with a sharp scriber, mark around the pattern, which is then removed and the work filed away to the line. If the hammer be a broken one, then care must be taken to have the pieces held carefully as they were before being broken. If the pieces be somewhat small and difficult to hold properly, warm them over a spirit lamp and smear the sides to be put against the blank, lightly with beeswax, and this will tend to hold them better in place and prevent their slipping.

To obtain a more permanent line and one that will show very distinctly in all its tracings, coat the surface on which the line is to be made with a film of copper. To do this take a lump of sulphate of copper, sometimes called blue vitriol or blue stone, wet it with water and rub over the bright surface of the work. The moisture will dry in a few minutes, leaving a surface or film of pure copper. Put the pattern in place and describe the outline. Upon removing the pattern the line will be found to be clear and showing very distinctly through the coppery surface. Three or four light rubs with the sulphate are sufficient to produce this surface, which is so very thin that it may be easily removed when the work is done with a fine file, or by rubbing with a bit of emery paper or emery cloth.

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CHAPTER XXXIII.

ON POWDER AND SHOT.

To Select Buck Shot.—The proper way is to put a wad in the muzzle of the gun, about half an inch down, and fit the shot in perfect layers; if this is observed, there will be no necessity to try them in the cartridge case, as they will be sure to fit. Buck-shot cast from a mould with nine to the 1¼ ounce, will just fit a twelve-bore barrel at the muzzle in a choke bore. If smaller shot is required, choose four to a layer, or five, and avoid the sizes that come between. At forty yards, all these pellets ought to go in a 26-inch circle, and the penetration be equal to a small rifle.

Weighing Powder, etc.—For weighing powder charges for rifles, Apothecaries' scales and the Apothecaries' table of weights and measures are used. The table is:

20 grains, 1 scruple;
3 scruples, 1 drachm;
8 drachms, 1 ounce;
12 ounces, 1 pound.

Powder is bought and sold by Avoirdupois weight, which has 16 ounces to the pound. The table is:

16 drachms, 1 ounce;
16 ounces, 1 pound.

The standard unit of weight of the U. S., is the pound, Troy weight, the table of which is:

24 grains, 1 pennyweight;
20 pennyweights, 1 ounce;

12 ounces, 1 pound.

The grain, ounce, or pound, Troy, and the grain, ounce, and pound, Apothecaries' weight, are precisely the same; but the ounce is differently divided.

The grain weight is the same in both tables. The pound Avoirdupois, like the pound Troy, contains 7,000 grains. The pound Apothecaries, contains 5,760 grains.

One pound of powder, Avoirdupois weight, will load 140 fifty-grain cartridges; 93 seventy-five-grain cartridges; 70 one-hundred-grain cartridges.

A dram Avoirdupois is equal to 27 11/32 grains.

In weighing bullets and powder in grains, Troy weight is used, and 437½ grains are equal to one ounce Avoirdupois. The drachm, Dixon measure, is 27½ grains, Troy or Apothecaries' weight.

COMPARATIVE SIZES OF SHOT.

SOFT SHOT PELLETS TO OUNCE.

Description	Sparks	Tatham	Le Roy	Baltimore	Chicago	St. Louis	English	Diameter of Shot
Extra Fine Dust		94,021						
Fine Dust		10,784						
Dust	5910	4565						
No. 12	3316	2326	778	2232	2400	2830		
" 11	1660	1346	992	1536	1414	1700		
" 10	950	848	822	815	854	1006	1728	
" 9	615	568	560	600	596	680	984	
" 8	426	399	375	365	434	490	600	
" 7	305	291	278	290	323	360	341	
" 6	245	218	209	190	246	250	280	
" 5	182	168	166	150	172	190	218	
" 4	130	132	121	125	146	158	177	
" 3	118	106	96	90	116	126	135	
" 2	90	86	82	70	92	95	112	
" 1	60	71	69	60	75	62	82	
" B	63	59	58	50	62	68	75	
" B B	55	50	49	45	53	55	56	
" B.B.B	48	42	44	40	46	....	47	
" A	..					50	....	
" A A	....					40	....	
" T	41	36	38	35	.	....	....	
" T T	36	31	32	30	.	....	....	
" O	..	..	.	..	38	39		
" O.O	.	.	..	..	33	34		
" O.O O	....	....	..	.	27	28	.	
" T T T	....	....	27	26				
" T T.T T	..	.	24	.				
" F	22	27	.	.		.	.	
" F.F	.	[illegible]	..	....		..	....	

COMPARATIVE SIZES OF SHOT.

CHILLED SHOT PELLETS TO OUNCE.

Description.	Sparks	Tatham	Le Roy	Baltimore	Chicago	St Louis	English	Diameter of Shot
No. 12	3328	2385	....	....	....	....	....	
" 11	1670	1380	....	....	....	....	....	
" 10	960	868					1700	
" 9	618	585					1000	
" 8	432	409	....	....	....	....	606	
" 7	318	299	....	....	....	....	850	
" 6	253	223	....	....	....	....	270	
" 5	190	172	....	....	....	....	220	
" 4	142	136					180	
" 3	120	109	....	....	....	....	130	
" 2	106	98	....	....	....	....	110	
" 1	89	78	....	....	....	....	80	
" B	....	61	....	....	....	....	....	
" B B	....	52	....	....	....	....	....	
" B.B.B	....	43	....	....	....	....	....	

COMPARATIVE SIZES OF BALLS

Description.	BALLS TO POUND. Sparks	Tatham	Le Roy	Baltimore	Chicago	St. Louis	English	Diameter of Shot
Buck 8	320	..		312			..	
" 8	..		.		320	....	..	
" 4	....	..	300		.	.	..	
" 3		288	270					
S S S G	..				.		272	
S S G	..	....	..	..			240	
Buck 2	312	325	238	250			.	
" 8	..					204	...	
" 7					212	194	...	
S G						....	176	
Buck 6					165	176	..	
! C				174				
Buck 1	165	172	160	182	.	.	...	
O	.			166		....	...	
Buck 5						147	...	
O	144	140	145	.			.	
M G		.					136	
C P	136						...	
Buck 5					136	....	..	
L Buck	128						.	
Buck 4						127		
O O			120	120	.			
Buck 4					113	.		
" 8						118		
O O	112	113						
R 4	100							
O O.O		100						
Buck 3					100			
" 2						97		
O O.O				88				
L G							88	
O.O.O	85		85					
Balls 38	..	85						
N P				85				
Buck 1						84		
" 2					70			
56				68				
R 3	65							
A P				63				
Balls 44		50				48		
Buck 1					50			
R 1	36							
33				32				
½ oz						32		
M 18	18							
M 16	16			16				

COLT PISTOL SIZES.

Colt 51	Buck 1				Buck 6			
" 36	R 4	000			Buck 5	Buck 3		
" 44	R 2	[illegible]			Buck 1	44		

COMPARATIVE SIZES OF GUNPOWDER.

Commencing with the Coarsest Grain of each Quality.

Common Sporting.				Fine Sporting.			
Oriental	Orange	Hazzard	Dupont	Oriental	Orange	Hazzard	Dupont
.. .. .	C .	. . . .	Fg.....	Falcon	.	Ameri-	...
Fg .	Fg	Fg	FFg	No 1		can.	
FFg ..	FFg	FFg	FFFg	" 2		No. 1	
FFFg	FFFg	FFFg		" 3	.	" 2	...
	.				.	" 3	..
.. ...	.	.			.	... .	
.....	.			.	.	. .	.
.....	.			.	.	..	...
							E R

Field Ducking.				Best Quality Sporting.			
Oriental	Orange	Hazard	Dupont	Oriental	Orange	Hazard	Dupont
Falcon & Wild Fowl				Diamond Grain	Lightning	Electric	
No. 4.	No 5	No 5	No. 1	No. 4	No. 7	No. 4	
" 5.	" 4.	" 4.	" 2.	" 3.	" 6.	" 3.	
" 2.	" 3	" 3.	" 3.	" 2	" 5.	" 2.	
" 1.	" 2	" 2.		" 1	" 4.		
				Fg			Diamond Grain
				FFg			
				FFFg			

Dupont's Eagle Rifle powder is the finest grain of sporting powder made; Oriental Falcon Sporting, No. 3 grain, is the nearest to it in [illegible]

CHAPTER XXXIV.

Miscellaneous Recipes
Soft Soldering
Good Soft Solder
Soldering Fluid
Brazing
To Braze Lugs on Barrels
Hard Soldering
Hard Solders, Three Formulas
Alloy for Adhering to Iron or Steel
Gun Oil
Gunsmiths' Glue

CHAPTER XXXIV

MISCELLANEOUS RECIPES

Soft Soldering.—Soft solder, so called, is a composition made by melting together two parts tin and one part lead. If the gunsmith ever has occasion to use it, he will need a soldering fluid, which is made by dropping clippings of zinc into muriatic acid until ebullition has ceased, then adding to the acid its equal in bulk of pure water, although some mechanics do not consider the addition of water as necessary.

Clean thoroughly the parts to be soldered together, then wet them with the soldering fluid. Next place in the joint a thin bit of the soft solder, and expose to heat, the heating agent to be clear of oil. The pieces should be held, pressed between the blades of large tweezers, so that when the solder melts the two parts will come directly together. So soon as the solder melts, the work must be taken from the fire, as the soldering will be complete. A little longer exposure would burn the solder and spoil the work.

Good Soft Solder.—Good soft solder is composed of equal parts of pure tin and good soft lead. The lead from old tea chests is excellent. Plumbers' solder is often made of lead three parts and tin one part.

Soldering Fluid.—A soldering fluid for jewelers' use is made by adding to alcohol all the chloride of zinc it will dissolve.

Brazing.—This consists in uniting iron and other hard-melting metals with a brass solder. Put the parts together as for soft soldering, lay the brass between the pieces or along the upper edge of the joint, if it can be held vertically, and add a goodly supply of pulverized borax to act as a flux. Heat over a charcoal fire till the brass melts and runs down into the joint, then take from the fire and cool. Before beginning the operation of brazing the parts to be put together must be made entirely clean, and then freshly filed to brightness.

To Braze Lugs on Gun Barrels. When not practicable to fasten the lugs by means of pins or rivets, hold them in place with binding wire. Take a piece of iron, say ¼ inch thick and 2 inches or more in width, and make in it a slot some larger than the lug to be brazed. Lay the barrel on the iron sideways, and pack up the lug so as to lie level, if necessary, also taking care that it is on straight. Pure copper is excellent for all kinds of brazing, when the color of the copper is not objectionable.

Hard Soldering.—See "To Solder Brass," in Chapter XII, which about covers the whole thing, varying only in the composition of the solder for different metals. The brass solder there described acts equally well for soldering copper, but for silver a solder is made composed of two parts silver and one part brass.

Hard Solders.—1. A hard solder that is yellow and easily fusible is made of copper, 4½ parts, and zinc, 5½ parts.

2. To hard solder iron use good tough brass or sheet copper, with borax as a flux.

3. Pure copper, cut in thin strips, with borax as a flux, is excellent for brazing iron or steel.

Alloy for Adhering to Iron or Steel.—Melt together, tin 3 parts, zinc 7½ parts, and copper 39½ parts. Clean the iron or steel, file to brightness and cast the alloy upon it. The iron or steel should be heated up to about the melting temperature of the alloy. This alloy will adhere firmly to the other metal, and as its rate of expansion is about the same as the iron or steel, under all circumstances, it will never come loose. It finishes up nicely and presents a very neat, light yellow appearance. Some gunsmiths use it for brazing purposes on account of its adhesive properties and its ease of fusion. It does not make so strong a joint as brass or copper, and therefore would not give so "honest" a job.

Gun Oil.—A good quality of sperm oil is undoubtedly the best oil to apply to gun work, especially the locks. Any fine animal oil may be used as a substitute. The oil from the fat of the woodchuck or ground-hog is admired by many. Fine quality of sewing-machine oil is very good. It must not be thinned or "cut" with kerosene or benzine, as this reduces its wearing quality. It must not thicken with exposure to the cold.

Vegetable oils are unfit for the locks of guns. Castor oil will gum up and become filthy in the extreme. Olive oil or "sweet oil" has very often been agitated, with common salt, nitric ether, sulphuric acid or hydrochloric acid to keep it from becoming rancid. Application of such oil, in addition to its bad lubricating quality, will rust and spoil work where applied

If desired to clarify oil, put in a bottle, say a quart of oil, and add about half a pound of fine lead shavings. In a short time the impurities will collect on the lead, when the clarified portion may be

poured off. Let the bottle stand in the sun for two or three weeks during the process, and then filter through fine white blotting-paper If some portion be found to congeal by cold, separate the clear portion from the other, reserving the uncongealed for use during exposure of the gun to cold weather.

Gunsmith's Glue.—Dissolve four ounces of good glue in sixteen ounces of strong acetic acid by exposure to gentle heat. This is not exactly a liquid glue preparation—it is only semi-liquid. It may be kept for any length of time desired, and, when wanted for use, a slight warming up is all the preparation necessary. The gunsmith finds it not only very convenient, in case he should have occasion to use glue about his woodwork, but also very good.

CHAPTER XXXV.

On Judging the Quality of Guns... ....
The Muzzle Loading Shot Gun.. ....
The Muzzle Loading Rifle ... .
The Breech Loading Shot Gun..... .. ..
The Breech Loading Rifle ....

CHAPTER XXXV.

ON JUDGING THE QUALITY OF GUNS.

The Muzzle-Loading Shot-Gun.—In the days when the gun of this character was at its zenith, its quality could be approximately decided upon by a glance at the manufacturer's brand which it bore, but at present that rule cannot be so safely trusted. Many of the houses which built for themselves a fine reputation by the manufacture of fine guns of the muzzle-loading order, have either ceased to exist, or have gone exclusively into the manufacture of breech-loaders, consequently the old brands, though they may still be met with, are not reliable. In truth they are more often dangerous signs than otherwise, in consequence of the fact that unscrupulous manufacturers not unfrequently apply them surreptitiously as an agent to aid in working off their bogus goods. It is, therefore, best to give brands but little consideration in judging the quality of new muzzle-loaders, trusting mainly on personal knowledge as to what a good gun should be, backed up by thorough test in all cases where such a thing is necessary.

The man capable of becoming a good gunsmith will require no special rules for his government in this matter. He will know that a steel gun is preferable to an iron gun, and he will be able to readily distinguish between steel and iron. He will also know that a gun finely finished in every particular, is, undoubtedly, a better gun than one put together in the rough, and his own eyes will quickly tell him as to the finish. Prompted by these considerations, the muzzle loading shot-gun is turned over to the good sense of the gunsmith for adjudgement as to superior or inferior qualities, leaving him to decide upon it, unbiased by any rules that could be given, which is the most rational course to pursue, since, under existing circumstances it would be impossible to make rules that would be entirely reliable.

The Muzzle-loading Rifle.—In the case of the old-fashioned Kentucky rifle, still on the market in limited numbers, eyesight and test, if necessary, will have to be the main reliance of the gunsmith in judging of quality. The barrel of a first-quality gun of this character is wrought iron, made eight-square, and finely finished. The lock is steel, well put up, and provided with double or set triggers. The stock is either black-walnut or maple highly polished and oil-finished. The bore is given as perfect a degree of finish as iron is capable of taking, and the rifles are deeply-cut and entirely regular all the way through. The sights are made with great care, some of the finest guns having an elevating hind-sight to be changed for long or short range—say, for 500 or 50 yards. In some of the older made guns the foresights are silver, though as a general rule they are made of some kind of white metal compound not so liable to glimmer as silver. The tube-cylinder has a vent screw in the end of it, which may be taken out for the purpose of working in powder in case a ball should have been accidently put down without powder, which accident, without this provision, would be apt to necessitate an unbreeching of the gun. The barrels are of different lengths, ranging from 26 to 40 inches, and the size of bore is equally varied. It is usually estimated by the number of round bullets a pound of lead will cast to fit it, as 200 (smallest bore), 175, 100, and so on down to 50, which is considered the largest bore in common use. The weight of the gun complete usually ranges at from six to twelve pounds.

A steel-barrel rifle made on the Kentucky plan may be met with occasionally, though not often. The steel barrel generally adds about five dollars in cost over that of the iron barrel finished in the same way, and is supposed to be at least that much better on account of less liability to wear and roughen in the bore.

The muzzle-loading rifle of more modern style differs very materially from the old Kentucky rifle in many respects. Mr. Barber, in his "Crack Shot," says of it that so many changes are constantly taking place, and opinions are so diversified, that it is really difficult to state what is the prevailing style; but he is of opinion that a barrel of from thirty to thirty-four inches in length, with a bore from thirty-eight hundredths inch to forty-four hundredths inch will be found to answer best for general purposes. If for sporting purposes exclusively the barrel ought to be a little shorter, perhaps, though he believes the great hunters of the plains use rifles with barrels of from thirty five to forty inches in length, and of a calibre so small as to enable them to make sixty round balls out of one pound of lead.

But, still adopting Barber, it is very difficult to lay down particular rules as to what a muzzle-loading rifle of modern style should be, as marksmen and gunmakers are both whimsical, and each has his set ideas and notions concerning the matter Some advocate a long barrel, while others maintain that anything beyond thirty-three inches militates against good shooting.

There are many prominent establishments engaged in the manufacture of modern muzzle-loading rifles, some of them carrying splendid reputations,

hence in this case a good deal of reliance can be placed upon brands. For instance, should a rifle be seen marked to Wesson, it is a guarantee of a good gun, for the reputation of the manufacturer is worth too much to admit of risking its tarnish by putting upon the market goods bearing his brand that are not fully up to all that is claimed for them.

And now that reference has been made incidentally to Wesson, a description may as well be made of some of the peculiarities of his muzzle-loading rifle as presenting a fair sample of a first-class gun of this order. And to do this under the best of authority, reference is made to Mr. Chapman's book on the Rifle, which is generally accepted as a standard work.

Referring to the Wesson muzzle-loading rifle, Mr. Chapman says that the barrel is made of cast steel, not highly carbonized, but thoroughly annealed in an air-tight oven. The length of the barrel is two feet eight inches when the loading muzzle is off. Outside, the barrel tapers a little from breech to muzzle, the difference in diameter being one fourth of an inch. The barrel is not furnished with a rib, except it be that the short tube at the breech can be called a rib, the peculiarity of stocking doing away with the necessity for a regular rib. The gun has a patent breech, which is made of iron case-hardened. It is joined to the break-off by the old-fashioned hook, with the addition of a half-lap joint, secured by a square-headed screw. Such a mode of fastening the barrel destroys the necessity for wood forward of the breech, and gives a peculiarly elegant and striking appearance to the arm. The loading-muzzle is put on by means of four steel wire pins about one-eighth of an inch in diameter and three-eighths long, and the holes for these pins are located as near the outside as possible.

The grooves of this rifle are cut with a twist, which turns the bullet once in three feet six inches. There are six grooves, and the spaces between them are left entirely square to the interior surface, presenting a kind of dove-tail appearance. The grooves are not quite so wide as the spaces between them. The breech is furnished with a vent or breathing nipple, about the diameter of a common pin, and bushed with platinum. The lock has back-action, furnished with a single set. The stock is of black walnut, made as straight as possible. It is furnished with a patch box, and also a small box to contain a wiper, which can be attached to the end of the ramrod. A globe sight is fixed into the stock, just behind the break-off, while a bead sight holds position at the muzzle-end of the barrel. The weight of the gun complete is ten pounds.

Of course it will be clearly understood that this description is not offered as of the best muzzle-loading rifle made, but simply because it happened to be convenient to make. There are, doubtless, other guns equally as good, and a preference of one over the other, in all probability, would have to be born of circumstances, as something peculiar in the tastes or requirements of the person by whom the gun was to be used, or in the particular line of use to which it was to be applied.

The Breech-loading Shot Gun. Gloan tells us that, in judging the quality of a breech-loader, there are other things to be taken into consideration besides the mere shooting of the gun. First among these is its safety relative to the person using it. There is more machinery and complication about it than there is about the muzzle-loader, and to that extent, if not made upon sound principles, and perfectly well made, it is more dangerous, to say nothing of being less durable.

But the principle must be a prime consideration, for, if a gun, no matter how well made, is constructed with a working movement which presents great strain and great friction, it must speedily wear out. Even the best breech-loader, with the soundest known action, must wear out sooner than would an arm of less complication, because some peculiar strain and friction cannot possibly be avoided; hence the great importance of passing judgment entirely favorable upon only the best.

The first thing to decide upon, then, is the principle upon which the gun works. No special rules can be given to govern in the formation of this decision other than that simplicity is always worthy of favorable consideration—the greater the simplicity the better, provided it works to the full accomplishment of all the ends desired. Next to simplicity may be ranked durability, and next to this may come in good shooting and safety. These last two considerations are put as third and fourth, when many persons would be inclined to rank them as second and first. Why this is done is because many of the most common guns are safe enough, so far as that is concerned, while not a few of them shoot very well for a while.

Some most excellent shooting has been done with extremely common guns, working upon a principle so complicated and so imperfect as to render it impossible for them to remain in order beyond a comparatively short length of time.

The English manufacturers, of good reputation, take great pains with their breech-loading shot-guns; hence, until within a very few years, English guns were considered entirely superior to those of American make, but now it is acknowledged, even by the English people, that in America we put up, at least, some guns that have no superiors. This last named fact has somewhat destroyed the weight of English brands with persons who are looking for a gun of the very best quality. But the advance on the part of American gunmakers is not the only thing that has worked against the reputation of English guns for being eminently the best. The gun-making business of Belgium has seriously injured the general good name of English guns, just as the watch-making business of Switzerland has injured the good name of English watches. For instance, Liege, in Belgium, is almost literally a city of gunmakers. It is estimated that there are now more small fire-arms made in Liege than in all the rest of the world put together, though Leige gets credit for comparatively few of them. The differ-

ent parts are manufactured there, and shipped to other countries as gunmakers' materials, where they are put together and branded with the name of a maker who really played no part whatever in the making. In Liege each manufacturing house is devoted to the manufacture of but a single part, knowing nothing whatever of the other parts manufactured at other establishments. As a result the gun made of Liege materials is simply a patchwork, and hence could not possibly be so reliable as a gun whose every part is made in the same establishment, and under the eye of the same general superintendent. England has gone largely into the putting up of these patchwork guns, simply for the reason that she can buy the Liege materials much cheaper than she can make them at home. This cheapness is due to the inferior materials used by the Liege manufacturers, and to the extremely low rate of wages in Belgium. It is asserted, upon good authority, that the English "manufacturer" can get his finished materials from Liege, paying regular Government duty, and put together what would appear to be a fair quality of double-barrel breech-loading shot-gun, at the cost of about seven dollars. And he does it, giving the gun to the market under his own brand, or surreptitiously under that of some other house known to be more reliable than his own. As a consequence, English reputation is sadly injured as regards the business of making the best guns, and gunsmiths can no longer trust to English brands as a sure guarantee of first-class quality. Of course there are some English manufacturers whom it will always do to trust, provided one knows to a certainty that the gun is really genuine.

If that patchwork game is played in this country at all it is on a small scale as yet, and is confined to the cheapest guns. A gun from any of our prominent houses is quite sure to be as represented; and, until the gunsmith becomes so familiar with all the requirements of a good gun, the maker's price may be taken as a pretty safe rule by which to judge of quality. Each manufacturing house is apt to have its guns graded, and priced accordingly—the higher the price asked the better the gun in every case, for it is as much the desire of the prominent manufacturer to make a good name as it is to make a good gun.

Of course this rule can only be considered entirely safe in case where the scale of prices has been obtained directly from headquarters. Passing through half a dozen or so of middle houses might work important changes from the original price list.

Where none of these rules can be brought to bear it is but natural that the inexperienced gunsmith should turn to his MANUAL for aid in forming judgment upon the quality of the gun. A few general ideas may not be out of place.

All the movements of the action should be smooth, and all the joints should fit to perfection. The locks should have due consideration. When the hammer is drawn back it should come with less and less resistance as it rises, and *vice versa* when the hammer is let down, exerting its greatest power immediately on reaching the nipple or firing-pin. But this increase and decrease of power should be extremely gradual, and not great. Throughout the movement there should be a steadiness and freeness, or, as Greener says, an oiliness, which when once realized, can never afterwards be mistaken. And when by a regular pressure upon the trigger the hammer is expertly raised and lowered in rapid succession, the locks should emit a clear ringing sound at the whole and half-cock with the resonance and regularity of beats in music. When once heard, this, too, can never afterwards be mistaken. The locks which perform to perfection under the tests mentioned are technically said to "speak well."

Turning from the lock to the lever, the latter should close with such ease as not to require any particular exertion of the wrist, and when closed it should hold with such a degree of firmness as to place safety, while discharging the gun, entirely beyond question. The wedges of the action should be fully and squarely set in the lump.

If a pin gun the pin should fit in the hole with nicety. If too tight, the barrels might not close, or the pin might be held back to such an extent that the cap would not be exploded. If too loose an unnecessary escape of gas at the discharge would be unavoidable, to the discomfort of the gunner and the weakening of the shot.

If a central fire the plungers should strike the centre of the cap unvaryingly. The hammer should come upon the plunger with a blow—not a mere push.

The countersink of the chambers, and the length and breadth of the action bed, should be closely observed. The countersink should be cut clean and deep enough to take the rim of the cartridge without leaving the slightest projection—else the gun will not shut perfectly. But if, on the contrary, the countersink be too deep the cartridge comes back on the breech before the charge makes its exit, which increases the recoil and renders accuracy less certain.

The central fire strikers should not be too short, an imperfection which might cause the discharge of the gun while closing it. On the other hand, they should not be too long, as that would interfere with the free motion of the gun. In the case of a pin gun the pin should invariably stand in exact line with the hammer, otherwise the blow would be apt to bend it, and the chances for exploding the cap would be less certain.

There should be no crevices between the wood and iron. If any such crevice exists between the stock and the false breech it is likely that the wood was green when put up, which would settle it that the gun was not the work of a responsible maker, for no such person would work imperfectly-seasoned wood.

The extractor of the central fire should never be permitted to escape the closest scrutiny. It should work without the slightest hitch, and its arms should enclose about one-half of the cartridge rim.

The countersunk should fit the rim precisely, in order that there may be no slipping.

The Breech-Loading Rifle.—Most of the rules suggested as aids in forming judgment upon the quality of the breech-loading shot gun, can be trusted as bearing with equal force in case of the breech-loading rifle. The makers of breech-loading rifles in the United States have won for themselves a noble reputation throughout the world, and, to be perfectly plain, there are very few unreliable manufacturers to be met with among them. As a consequence, there is not much risk to run in passing judgment upon a breech-loading rifle of American make. The first thing to decide upon is the principle, if there is a preference in this direction. Such decision brings up the gun of some particular maker, after which the road is easy enough—the price set upon the grade of gun by the maker, may always be accepted as a clear indication of its quality.

In referring thus to American rifles the idea is not advanced that good guns are not made in other countries—such a position would be going wide of the truth. There are *some* gunmakers in England who turn out the finest rifles that the world has yet seen, and the most costly. They are models of perfection in every particular, but when the best shooting is ascertained it is discovered that they have not proven themselves superior in that respect, to the more substantial (generally speaking), but less finely finished and less expensive guns of the American makers. It is this matter of a really good rifle at comparatively low figures that has given the American product such an enviable reputation throughout the world.

Then there is another reason for favorable mention of American rifles in cases where the quality of the gun is to be judged—there are fewer chances for meeting with counterfeits on American guns than there are on guns of foreign make. Here the gunmaker is so deeply concerned in his own good name that it would be very unsafe to attempt running a "bogus" upon him—he would trace it to the "last ditch." Not so in case of the English maker—having no direct interests thrown all over this country like a network, as have the American makers. he would, in all probability, never hear of the bogus gun branded to him and sold on his good reputation for many times more than it was really worth.

In case where there are no means of getting at the quality of a rifle from the grade affixed and tests made by a responsible manufacturer, the gunsmith will of course be forced to fall back upon his own resources What these are we need not state. The gun must be subjected to a most critical examination in every part, in obedience to rules laid down for examining breech-loading shot guns, after which its shooting qualities must be thoroughly tested. To no botch at the business can be trusted the shooting test, if it be wished to decide whether or not a certain rifle can be recommended as being of first-class quality—the work must be performed at the hands of an expert, and it must be continued until is secured unmistakable proof as to how the gun shoots. When a man buys a good rifle he does it in the expectation of becoming the owner of a gun qualified to shoot well, and, no matter how perfect it might be in all other respects, the slightest deficiency in this particular would be sure to rouse a high degree of uncompromising dissatisfaction.

CHAPTER XXXVI

On Using the Rifle. . . . . .
The Old Kentucky Rifle . . . . . .
General Directions. . . . . .
Off-Hand Shooting . . . . . .
Rest Shooting. . . . . .

CHAPTER XXXVI.

ON USING THE RIFLE.

The Old Kentucky Rifle—The old backwoods hunters who used the long Kentucky rifle, had really but a very imperfect idea of its capabilities. The gun was provided with a hind and a fore-sight, the latter a "bead" located near the muzzle and rising but little above the common level of the surface of the barrel, and the former a small vertical plate set in the barrel a short distance in advance of the lock, and containing in the centre of its upper edge a fine slit through which to look at the "bead" in the act of taking aim. The hind-sight stood further above the barrel than the fore sight, but why it so stood was something about which the owner seldom concerned himself. Of course the gunsmith knew it was for the purpose of setting the "aim" below the starting line of the bullet, in order that the natural curve in its flight might be accommodated, but this was usually a secret of the gunsmiths which nobody cared to possess The sight was immovable, could neither be raised nor lowered, consequently the gun could not be adapted to circumstances of long or short range. The elevation of the sight usually crossed the line of vision and that of the flight of the bullet at about one hundred yards distance, hence the shooting at shorter range was apt to be a little too high and too low at longer range. At two hundred yards it was merely accidental, though the bullet struck with a degree of force apparently unabated at that distance. If the hunter killed his game at two hundred yards, he did it by aiming a few feet too high for a sight at one hundred yards, consequently he never shot at that distance so long as there was a prospect of being able to creep nearer. And yet, with the right kind of elevated sight the gun would have been equally as effectual at two hundred yards as at one hundred; in truth it would have been good for four and perhaps six hundred yards, but the old hunter had not so much as a dream of any such thing, but went creeping about through the woods endeavoring to steal upon his game, unconsciously carrying upon his shoulder an instrument that with so simple a contrivance as an elevated sight of proper grade might have brought it down almost as far as the eye could have seen it. And the game well knew the limited capacity of his gun, particularly the deer, which would frisk off to the distance of about three hundred yards and there stop, turn around,

stamp their feet and "whistle" at him in apparent derision. Ah! that he had understood the real capabilities of his gun, and had suddenly invented and applied an elevated or long-range sight made after some of the approved modern plans, how he would have astonished them!

In those days of pioneer life in the States now no longer on the frontier, "match shooting" (it was not called target shooting, then) was always confined to a certain distance, sixty yards off-hand or one hundred yards with a rest. The marksman was permitted to take his own choice of modes. "Shooting matches" were very common in those earlier times, usually for beef. A fat ox was put up to be shot for at so much per shot, something on the plan of the modern raffle. When the amount asked for the animal had been made up, the shooting commenced. The best shot took first choice, which was one of the hind quarters of the ox, the second best took second choice, which was the other hind quarter; the third best took third choice, which was one of the fore quarters, and so on to the fifth choice, which consisted of the hide and tallow. Happy occasions, indeed, were those old "shooting matches," and splendid, indeed, was some of the shooting. A regular attendance upon numerous target matches of more modern times, with all the modern appliances, in the hands of marksmen with national reputations, has never shown us better shooting at sixty yards, off-hand, or one hundred yards with a rest.

General Directions.—Mr. Edward C. Barber, author of the "Crack Shot," says the greatest care and nicety is required in loading any kind of rifle, if we desire to have it shoot with accuracy. A few grains too much or too little powder will alter the range of the bullet, and the bullet itself, if not placed in the barrel exactly right, in the case of the muzzle-loader, will come out at an irregular angle, and, instead of going straight to the mark, will be turned sideways. This trouble is avoided by the use of a "starter," to be had at any gun store.

Supposing that a young man has just possessed himself of a rifle, but who knows nothing of its use save such information as he has been able to gather from mere theorists. He makes choice of a suitable place for taking his first practical lesson, where there is no danger of inflicting harm upon disinterested persons. He puts up his target and steps off fifty yards, or it might be better to measure it more accurately than by stepping

Suppose the gun to be a first-class modern muzzle-loader. The target is now arranged; proceed to load. Grasp the barrel of the gun near the muzzle; turn it round so that the lock is outward, then pour from the flask the proper charge of powder, using the charger which the gunmaker has furnished. Be sure that the charger is exactly full -no more nor less. Pour the powder gently down the barrel, holding the latter upright so that none of the powder will lodge in the grooves or rifles. Get ready a "patch," which has been previously prepared by oiling on one side a piece of fine but substantial linen with sperm oil such as is used for sewing machines, and cutting out with a "patch cutter," always to be had with a new gun. Place this patch over the muzzle, oiled side downward, and then set the bullet perfectly straight and true in the muzzle, and with the "starter" press it downward two or three inches, using the ramrod to force it home. Avoid the common error of "ramming" home the bullet, for two reasons: firstly, because the bullet being jammed on the powder meals and grinds it, thereby depriving it of a portion of its strength, and, secondly, because injury is done to the face of the ball, which works against its taking a perfectly true and accurate flight. The old plan of making the ramrod rebound to prove that the ball was home, as mentioned in another chapter, was wrong. Nothing more than a moderate pressure is necessary, and if you are not willing to trust to this a mark on your ramrod, to come exactly to the muzzle when the ball is entirely down, will always tell the tale. Now place a cap on the tube or nipple, which is, doubtless, full of powder, and the "shootist" is ready for operations.

There are two modes of shooting with a rifle: off-hand, and with a rest, as has already been intimated. Choose the mode that suits best, and begin practice.

Off-hand Shooting.—Barber says the position which should be chosen for off-hand shooting is one that admits of a good deal of discussion. There is great difference of opinion on the subject, some good shots contending that they never could see any difference in their shooting, whether they were in one position or the other; while others maintain that it is absolutely necessary to good shooting that certain fixed rules should be adhered to. There are three recognized methods of firing, viz., the British or Hythe position, the Swiss position and the American position. In the first named, the rifleman stands perfectly erect, head slightly bent forward, feet at right angles to each other, the left advanced about twelve inches, the right arm raised well up, the left hand advanced so as to take a firm yet easy grip of the rifle, the butt of which is to be pressed firmly against the right shoulder, the right hand grasping firmly the small of the stock. Captain Henton describes the second method, or Swiss position, by stating that no particular manner of placing the feet is required. The whole body is kept perfectly rigid, the chest expanded as much as possible, against which the left elbow is allowed to rest, the rifle being held with the left hand as near the trigger guard as it can be placed. The Swiss rifles have a kind of handle provided for this purpose. The upper part of the body is thrown back. Before firing the Swiss marksman invariably takes a long, deep inspiration, which he holds until the bullet has left his rifle, when he breaks the suspension with a loud grunt of satisfaction if the shot happens to please him. In the American position, to draw again from Barber, the legs are kept wide apart, body slightly bent backward, the left shoulder a little back; with the left hand he grasps the rifle

well out, bringing the arm nearly under the barrel, so as to form a support; the right arm is thrown out square, similar to the style adopted in the English position. The butt of the rifle is not pressed against the shoulder, but in the hollow between the biceps muscle and the shoulder. Cleveland prefers this method to that of the English, but Barber does not, as he considers it more constrained than the other.

But, of course, great men must differ; the world could not get along all right were it otherwise. The matter of method had best be left to stand as a matter of taste, or of feeling as to convenience to the marksman, as very good shooting has been done through all of them

Having settled this point, bring the rifle up carefully into position, the eye being steadily fixed upon the object to be fired at; slowly raise the barrel until the sights and the object are in direct line, and the instant that this condition is fully apparent press upon the trigger, still keeping the eye steadily on the mark.

It is always best to hold the breath at the instant of firing; and in pressing the trigger the forearm alone should act, the arm and wrist being stationary. No other movement of the body or any member thereof should take place between the time of securing aim and discharging the gun. The aim should be quickly taken—a long dwell, with wabblings on and wabblings off the mark is apt to do more harm than good. On this point Frank Forester says: "Though it is necessary to get a sure aim before firing, it is not necessary to dwell on it before doing so. Every second between having taken true sight and the giving fire is a second lost, or worse than lost; for the longer the rifle is held to the face, the greater the tension of the muscles and nerves, and the likelier are both to shake and give way. The first true sight is always, with all firearms, the best sight, and a quick shot has as much or more advantage over a slow shot, with the rifle as with any other weapon." Barber says he considers "the *pull* of the trigger a very important consideration; it should not be too slight, so as to go off almost involuntarily, nor so hard as to require force, but so that, by a gentle pressure, commenced at the moment of taking aim, the slightest extra squeeze will cause the hammer to fall at the very instant when the aim is perfected"

Rest Shooting.—If the old-fashioned backwoods hunters shot with a rest at all that rest had nothing complicated about it, being usually only the side of a tree. The rifle was brought up against the side of a tree and pressed there with the left hand, which held it pretty much after the plan employed in the American method of off hand shooting. If the object to be fired at was occupying an elevated position, as a squirrel among the branches of a neighboring tree, this kind of rest was a very easy and good one, but it was not so easy where a horizontal shot had to be made. In match shooting with a rest the most common plan was to lie upon the ground, face downward, somewhat in the natural position of a swimmer, and put the gun out in front, its muzzle resting upon a small log or block of wood. These plans are still more or less in vogue in all regions where the old-style Kentucky rifle remains in common use.

The most popular modern rest, according to Barber, is to have a bench made about three and a half feet long and ten inches wide, with four stout legs standing out at considerable angle. The height should be about level with the breast when sitting down. At one end place a stout piece of wood about five or six inches high, crosswise, with notches cut in it to lay the barrel in. It should be well covered with cloth or some other soft material, and should be securely fastened to the bench. The end of the bench nearest the shooter may be hollowed out a little for the breast to fit in. This is a rest for target shooting—it would not be well suited for the hunter to carry around in the woods with him, of course.

The same authority tells how to make a cheaper rest, by tying three moderately stout sticks together near the top, and then throwing out the other ends upon the ground after the manner of the feet of a tripod. Place your coat in the crotch formed at the top to rest your rifle upon—that is all there is of it.

Having decided upon the kind of rest to be used, the question of rest-shooting is settled, as everything else is performed the same as in shooting off-hand. Most modern sportsmen object to rest-shooting to such an extent that no artificial rest is admitted at their target matches. Their reasons for such objections are that a rest is an inconvenient arrangement that could not be employed either in war or field-sports, and hence, people ought to learn to shoot well without it. And they do, but in many instances they shoot with a rest at last, making one of themselves by lying upon the ground and shooting off the knee or some other part of the person, or by setting the elbows upon the ground so as to brace with the gun as permanently as any artificial rest could possible be. The methods employed by the noted marksmen, Messrs. Fulton and Bodine, were of this character.

CHAPTER XXXVII

Of Using the Shot-Gun.....
Born Shooters.....
How to Shoot.....
Brewster on the Use of Two Eyes.....
Dougall's Reasoning.....
Ideas on Taking Aim.....

CHAPTER XXXVII.

ON USING THE SHOT-GUN.

Born Shooters.—Every man who uses a gun at all will feel an ambition to use it skillfully, and when he finds himself falling short of his aspirations he will apply to his gunsmith for instructions, for the gunsmith is expected to set the owner all right as well as his gun. There will be some difference in results to the gunsmith, however, for when the gun gets out of fix, and the gunsmith repairs the imperfections, the owner expects to pay for services ren-

tered, but not so with reference to himself. He will expect the gunsmith to spend an hour or so in telling him how to shoot, but it will not occur to him that time is worth the same in dollars and cents spend it as we may, hence he will never think of tendering the slightest remuneration for the time consumed in giving him instructions. We have often thought that a chapter in some book telling about all there is to tell the novice on the subject of shooting would be worth a great deal to the gunsmith, as he could turn it over to his inquiring customers and go on about his work, leaving them to sift out from the "black and white" the information desired, taking their own time for it, and digesting everything in accordance with their own notions. And right here, it may be remarked, is a proper place to put in just such a chapter, which is done without further preface.

Some popular writer has said that, like the poet, the first-class shot with a gun, or the "dead shot," as he is often called, must be born such—he cannot be made. Good shooting is a fine art, and in none of the fine arts can perfection be acquired where there does not exist a natural talent, or natural capacity, if the term be better. Any man with fair calculation and a reasonably good mechanical eye may, by practice, become a very passable shot, but without this peculiar natural requirement, which no one can clearly explain, it will be impossible for him to ever excel as an expert marksman.

It is not often that a real born shot is met with—they are about as scarce as true poets and true painters. When one does meet with him one soon knows him, if there is any shooting going on. Perhaps he is at his first shooting match. He does not know himself as a "shootist," possibly. Curiosity alone, it may be, prompts him to try a shot, so he takes the gun, and wholly without study or previous experience, blazes away, and, to the astonishment of all present, shoots almost to perfection. It is in him as a gift. Some peculiar balance in his organization is the cause of it, and it is folly to be envious even in the least degree. Nor is it worth while to despair because such a peculiar balance of organization did not happen to fall to "our" lot. If there be a wish to succeed, a little patient study, industry and practice may soon bring the "shootist" up to the average at least, and that will leave no reasonable cause for complaint

How to Shoot —This part of the subject need not be brought down to the simple operation of merely discharging a gun, for it is supposed that every person with common sense, and old enough to handle a gun would know how to discharge it when loaded. What is meant, then, by "how to shoot," is how to shoot well, and to enable any one to do this, one of the most important requisites lies in taking aim on the object at which is expected to be shot. Most young gunners close one eye in this operation, which, according to the best authorities, is entirely wrong A man will learn to take correct aim with a shot-gun much sooner by keeping both eyes naturally open than he will by holding one closed. Once got in the habit of shooting with a closed eye, it will be found a most difficult habit to break up—the "hiding eye" will "close up" just as the finger is being pressed upon the trigger. And with that "closing up" is very apt to come a deviation of the gun from the line of correct aim.

Some years ago Mr. Dougall, in his "Shooting Simplified," advanced many strong arguments in favor of shooting with both eyes open, basing them upon correct science. He says the person who takes aim with one eye closed has robbed himself of half his vision. The single open eye cannot see the whole of the object at which it looks, but only a part, or one side of it. Then, it requires the use of both eyes to see and calculate distance correctly. One eye may outline a thing, but it calls for the employment of two eyes to give it a perfect perspective.

When an object is hastily caught within the range of both eyes, the sense of vision is instantly assured as to position of the object, its distance from the gun, and, if moving, the rate of speed at which it is going. By a mental operation the brain is promptly impressed with all this, giving confidence and, consequently, calmness. Here the main point favoring success has been attained—calmness and a strong belief that the shot is going to succeed. The moment when this is felt is the one in which to press upon the trigger. It means that a correct sight is secured, whether there be time to think about it or not, and hence an instantaneous discharge of the gun is almost sure to bring down the game.

Since beginning to write this book one of the authors interviewed a wonderfully successful sportsman with reference to his mode of taking aim at birds on the wing. "Why, bless your soul!" said he, "I never take aim at all. I throw my gun in range of the bird, look at the bird with both eyes open, and the moment a feeling comes over me that I shall kill the bird if I shoot, I pull the trigger, and it's about always my bird." So it is. But this expert is evidently mistaken with reference to taking aim: he takes aim mechanically. He thinks only about killing the bird, without thinking about taking aim, and in response to the securing of a perfect aim comes the feeling, unexplained in his thoughts, that if he shoots he shall kill the bird. It is simply a powerful concentration of thought, which is always of paramount importance in shooting. A mind scattering over all creation at the time of shooting is no more to be depended upon for good results than a gun scattering to all sides of a ten-acre field. There must be concentration in both cases. A man cannot buy goods, grow crops, swap horses, make poetry, edit a newspaper and kill birds on the wing with unvarying success all at the same instant.

Brewster on the Use of Two Eyes.—As the novice who has not devoted much thought to the subject of shooting, will be apt to feel some surprise at the idea of the use of both eyes being recommended in

taking aim, the liberty will be assumed of quoting a paragraph from the writings of Sir David Brewster, offering it as evidence in substantiation of the foregoing position. In his able work on the Stereoscope he says. "When we look with both eyes open at a sphere, or any other solid object, we see it by uniting into *one* two pictures—one as seen by the right, and the other as seen by the left eye. If we hold up a thin book perpendicularly, and midway between both eyes, we see distinctly the back of it and both sides with the eyes open. When we shut the right eye, we see with the left eye the back of the book and the left side of it; and when we shut the left eye, we see with the right eye the back of it and the right side. The picture of the book, therefore, which we see with both eyes, consists of two dissimilar pictures united, namely, a picture of the back and left side of the book as seen by the left eye, and a picture of the back and right side of the book as seen by the right eye."

This argues that the sportsman who closes one eye at the time of taking aim at an away-going bird, really has a very imperfect view of it—but half a picture, as it were—hence the aim could not possibly be so perfect as in case where the picture was rendered more distinct by the use of both eyes, in accordance with the clear explanation of Sir David, who goes on to state

"But though we see with one eye the direction in which any object or point of an object is situated, we do not see its position or the distance from the eye at which it is placed. In monocular vision we learn from experience to estimate all distances, but particularly great ones, by various tests, which are called the *criteria* of distance, but it is only with both eyes that we can estimate with anything like accuracy the distance of objects not far from us

"The most important advantage which we derive from the use of two eyes is to enable us to see distance, or a third dimension in space. That this vision is not the result of experience as monocular vision is, is obvious from the fact that distance is seen as perfectly by children as by adults; and it has been proved by naturalists that animals newly-born appreciate distance with the greatest correctness."

Dougall's Reasoning.—Mr. Dougall says, in his "Shooting Simplified," that "A thorough good gun will knock over a hare running broadside, with four or five shots at seventy yards distance, but full elevation must be taken, and the gun fired with the head well raised and the eyes kept steady on the aim, *not* taking sight along the rib, with the eye well down behind the breech, as has been erroneously recommended.

"Distance requires elevation in proportion. A rifle is fitted with graduated sights to meet this, but the elevation of the rib of a fowling-piece is fixed and immovable. But by a simple law of perspective, when you look at a hare (or any other object) seventy yards away, bringing mechanically the sight to bear upon it, you have the breech of the gun lower than if it were only forty yards off; whereas, if you adopt the one-eye system, you fire at exactly the same elevation at all distances. It would be as absurd to take a level aim along the rib at seventy yards as it would be to fire a rifle at a mark at two hundred yards with the sight set for one hundred.

"While everything has been done to increase the range of the fowling piece, nothing has been done to give the elevation necessary to take full advantage of the increase of power. As long as the one-eye system of shooting is adopted, the object, if hit at all, will be struck only by outside weak pellets, and not by the effective central shot.

"The proper way is to throw the gun well up and into the shoulder; the setting off of the stock will then bring the gun right in front of the face; and, the head being erect, and both eyes fixed intently on the object, the line of motion is commanded, and the aim taken instinctively. The central pellets have thus an allowance given them to compensate for distance and the motion of the object. You look along the imaginary line, higher at the breech according to distance, and at this elevation the gun is fired, exactly as a rifle target-shooter sets his breech sights to a given distance.

"How does a man drive a nail? Certainly not by closing one eye and looking along the hammer; but with both eyes open, he mechanically balances the hammer and strikes instinctively, never, if accustomed to the use of the tool, missing his aim. It is the same in shooting."

Coming directly to the subject of employing binocular vision in taking aim to shoot, Mr Dougall quotes from a paper in *Once-a-Week* to the effect that monocular vision, while much employed for this purpose, cannot at all be depended upon To prove this position, place upon a table an empty small-mouthed vial, and taking another similar vial full of water in one hand, shut an eye and approach the vial upon the table; when apparently near enough, stretch out your arm quickly and endeavor to pour the water from the full vial into the other, still keeping the eye closed. You will be very apt to find, as the water comes down, that it is missing the mouth of the empty vial on account of a miscalculation, due to monocular vision. Now repeat the operation with both eyes open, and if care is exercised success will be the invariable result. A similar miscalculation will be shown to the person who endeavors to approach and snuff a candle with one eye shut.

Mr. Dougall thinks there can be no reasonable question as to the advantages of learning to use the shot-gun with both eyes open This has been proven time and again by the most rigid tests. It is even a settled fact that the nearer the eyes of an individual set together in the head the less he is likely to shoot well. "And yet," says Mr. Dougall, "how strange it is to find sportsmen who would still further narrow this fine provision of nature into the diameter of one retina only Throwing the fowling-piece into a line with the object of aim by an instinctive effort, keeping both eyes firmly fixed on and following the flight of the object, is the first great principle in shooting well."

Gloan on Taking Aim.—The clever author of a neat little book entitled "The Breech-Loader," tells us that when the shot leave the gun the powder which propels the pellets has started them with sufficient force to keep them up for a short time against all natural resistances acting upon them, but finally gravitation, which is pulling upon them all the time, begins to tell, and carry them downward from the line upon which they set out.

"The shot have a journey to perform after they leave the gun, and before they reach the bird. It may be a long journey or a short journey, according to the distance of the bird; but still it is a journey, and it takes some time to do it in. While the shot are traveling on their way, the bird is flying on *his* way. If the bird is flying across the shooter, and the aim is at the bird, naturally, by the time the shot get to the point of aim, the bird has gone on beyond it, and is untouched by the shot. And if the distance is great, gravitation has affected the shot and pulled them down below the point of aim. Possibly, too, the wind is strong, and has blown them a little to one side. So that, assuming that a sportsman aims steadily and exactly at a cross-flying bird, sixty yards distant, going a mile a minute, the gun making a pattern good enough to kill, what results!

"When the shot arrive at their point of destination they are from eight to ten feet behind the point to which the bird has flown; and they are from ten to twelve inches below the line upon which the bird was flying. If the wind is high they are blown aside, even on the lower line, and the other pellets become harmless if they hit. The bird escapes, as a matter of surprise to the young sportsman, who is confident that he 'covered it exactly'

"He did cover it, literally, and exactly, and that was the cause of the miss. If he had aimed the length of a fence rail ahead of the bird and half the length above it, he would probably have brought it down. As the shot was, however, the bird was sure to be lost

"An old shot will shune on range and allowance. His eye will measure distance as though with a tape-line. He will estimate velocity as with a registering instrument. He makes his cheek an index of the wind, and before his gun is at his shoulder he has decided with unfailing skill where the aim must be, and there he plants the load. If the bird does not fall it is the gun's fault, not his.

"By the binocular vision these difficulties, which are so trying to the novice, are the more readily overcome. The eyes take in the flight of the bird, and convey the rate of speed at which it flies. The full distance of the whole perspective of the landscape is made palpable to the sense, and the finger responds to the call, which is made all the more quickly and all the more truly because of the certainty which the eyes impart."

CHAPTER XXXVII.

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Natural Talent.....
Taking Aim.....
Gun Judging.....
The Best Pistols to Use.....

CHAPTER XXXVIII.

ON USING THE PISTOL.

Natural Talent.—The number of persons who are really good shots with the pistol is smaller than one would be apt to suppose after considering how many weapons of this kind are in every-day use. They are almost as common as pocket-knives, and some of them are capable of shooting reasonably well at considerable length of range, and yet not an average of one man in five hundred, who owns a pistol, could be found, perhaps, who could put fifty per cent. of his bullets through a hat set up for a target ten paces away. The fact is, the pistol, while capable enough, if well made, is the most difficult of all our fire-arms to manage, so far as relates to good performances. There are men who can take a good revolver and shoot a chicken's head off every time, ten or fifteen paces, but of such men there are not very many And none of them have ever communicated how they happened to become such fine shots with the pistol. In some cases they had practiced a good deal, but not more than had hundreds who were but comparatively poor performers. To come squarely down to the point at once, the peculiarity which made them good shots with the pistol was a "born-gift," as in the case of the best shots with the shot gun. Any man who practices with the pistol, in accordance with the established rules governing its use for best results, may soon become a fair shot, but it calls for more than mere practice to make him an excellent shot.

Taking Aim.—The best shots do not take aim by sighting along the barrel of the pistol, holding it out at arm's length after the manner of the wooden figure standing in front of the city shooting-gallery. They do not close one eye and turn sideways to the object of aim like the ideal duelist, but they hold out the pistol, look at the object (not the pistol), with both eyes open, and blaze away, usually putting the bullet about where they want it to go. There is really no aim-taking in the case, any more than there is in the case of a boy playing at marbles. Indeed, shooting a pistol to the best advantage is very much on the same principle as shooting a marble. The boy takes the marble properly between his thumb and first finger, holds out his hand in the direction of the marble to be shot at, but considerably below his line of vision, looks at the object-marble with both eyes open and "flips" in obedience to the promptings of a kind of unconscious calculation as to distance, force at command, effect of gravitation, and so on. The marble "flipped" curves out on its way, and, if shot from the hand of a skillful player, strikes its mark with astonishing certainty. Just so with the bullet sent from the pistol; under the management of a skillful performer it goes in obedience to an unconscious calculation, and not in obedience to the squinting of one eye along

the barrel. Sight-taking won't do in either case; the good marble player would be a hopeless failure if he held up his arm to his line of vision and took sight every time he went to "shoot" the pistol-shooter who performs upon the same plan is invariably a marksman of sterling uncertainty, to say the least.

Cane Aiming.—Some people are so deficient in the species of calculation necessary to successful pistol-shooting, on the plan suggested in the foregoing, that they cannot do much at it. Such as these have some excuse for taking sight, but holding the pistol out at arm's length and sighting along the barrel or through its "sights" rarely gives them more than very little certainty. The best method of actually taking sight with a pistol is performed in connection with a rod some three feet long—usually with a walking cane. Grasp the grip of the pistol in the right hand, in the usual way, and take the cane in the left hand. Bring the handle of the cane up against the shoulder like the breech of a gun, pass the pistol down along the side of it till the barrel reaches the left hand, and both hands are in easy position. Hold the cane between the thumb and first finger of the left hand, letting them pass beyond it and grip the barrel of the pistol between the end of the thumb and the turned-up end of the finger. Let the thumb and first finger of the right hand also grip the cane beyond the "grip" of the pistol. The aim of the pistol should range a little to the right of the direction pointed by the cane, which it will very naturally do.

This plan steadies the pistol and affords as fine an opportunity of taking perfect sight as one could have with a rifle. A little practice with it, to enable one to arrive at a certain conclusion as to the rise or fall of the bullet, will soon pave the way for pretty fair shooting. A kind of clasp with which to fasten the pistol to the cane is now on the market, and may be made to work very well, though some would always prefer holding the pistol with the hands, in the manner just described.

The Best Pistols to Use.—It is not advisable to say a recommendatory word about any particular make—how could it be done, under the above heading, when there are twenty or thirty really good pistols now before the the public under the brand of the same number of different manufacturers? The best pistol for any person to use is any good pistol that this person happens to like, and no other kind. All pistols do not shoot alike, and, hence, when any one has practiced with a certain kind until accustomed to its peculiarities they had better stick to it, as a change would be apt to throw at least some derangement in the shooting calculations, putting them under the necessity of a repeated practice. All the best shots invariably stick to some particular make of pistol, and usually to some particular size.

In making choice of a size it is best to be governed by the character of work the pistol is desired to perform. The large pistols shoot stronger, and, as a general rule, with greater accuracy than the small ones; still, comparatively small pistols are sometimes known to shoot reasonably well. They are intended only for short range, however, and hence must not be depended upon when a good performance of long-range pistol shooting is desired. The large pistol has many advantages over the small one, while the latter can claim but two over the former. These two consist in its lightness, fitting it to figure as a pocket pistol, and in the lesser cost of its ammunition.

CHAPTER XXXIX.

Vocabulary of Mechanical Terms Used by Gun Makers...

CHAPTER XXXIX.

VOCABULARY OF MECHANICAL TERMS USED BY GUN-

Action.—The iron bed attached to the stock of a breech-loading gun, into the recess of which the lump descends and is secured. The term is used generally as "side action," "snap action," etc. The word is also used to indicate the different form of gun locks, as back-action, bar-action, front-action, etc.

Anneal.—To render more soft, as in the case of iron and other metals.

Auxiliary Rifle.—A rifle-barrel some twenty inches in length, and so arranged that, like a cartridge, it may be slipped within the barrel of a breech loading shot-gun, thus at once converting the shot-gun into a rifle. The rifle-barrel, charged with its cartridge, may be placed in the shot-gun in a moment and at pleasure.

Back-action Lock.—A lock that is located entirely back of the barrel, being bedded in the stock alone.

Bar-action Lock.—When the lock is bedded partly back of the barrel and partly along side of it.

Barrel.—The iron or steel tube of the gun through which the charge passes in the act of firing.

Barrel loop.—A metallic loop under the barrel, through which a small bolt passes to hold the barrel into the stock.

Beats.—The notches in the tumbler of a gun-lock.

Black-Walnut.—A tree, native to North America, whose wood is extensively used in the manufacture of fine gun stocks; the *Juglans nigra* of botanists.

Binocular Vision.—Seeing with two eyes.

Bolt.—The part which, in a breech-loader, passes into the lump of the barrel and holds it into the action when the gun is closed.

Bore.—The interior of the barrel along which the charge passes.

Bores are made of the following forms: True cylinders; cylinders enlarged at the breech; cylinders enlarged or freed at the muzzle; tapered to narrow at the muzzle; narrowed to close at the muzzle; cylindrical, with ring cut out near muzzle; narrowing the muzzle with depth cut out, modified, etc. Bores are also made elliptical, hexagonal, polygonal, etc.

Brazing.—Soldering iron with brass or copper as a solder.

Breech. —In earlier days all that portion of the gun back of the lock was considered *the* breech, but now a gun is regarded as having two breeches: the breech of the barrel, the place where the cartridge is inserted, as in the case of the breech-loaders, and the breech of the stock, being that part which comes against the shoulder.

Breech-bolt.—A small iron bar used in some make of guns to assist in holding the barrel secure to the action.

Bridle.—That piece in the lock connected with the tumbler as a kind of cap.

Browning.—A rust produced on the surface of gun-barrels by means of acids.

Bump.—The corner of the stock at the top of the heel plate.

Burnisher.—A piece of smooth and hardened steel used in polishing the surface of metals

Calibre.—The diametrical measurement of the bore of a gun barrel. Breech loaders are made of 10, 12, 14, 16 and 20 calibre. Muzzle loader of every variety of measurement.

Cap —The metal covering placed on the end of a pistol handle. Also the small cup-like contrivance put on the nipple upon which the hammer strikes to fire the gun.

Carbine.—A short form of rifle; so made to be easily carried by persons who used them mounted on horses.

Cartridges.—The ammunition for a gun, contained in metal or paper cases. They are sized to regular numbers, as gauge 10 or 12, etc., and are of two kinds, central-fire and rim-fire.

Case-hardening.—A hardened, steel like exterior given to iron by heating it in connection with animal charcoal, and then plunging while hot in cold water.

Central-fire.—Setting off the cartridge by striking it in the centre, where the fulminate is placed.

Chamber.—The enlarged space in the breech of the barrel wherein the cartridge is placed, or where the charge rests in the case of a muzzle-loader. The bores intended to receive the charge in the cylinder of a revolver. In loading a gun with coarse shot, if they rest in the barrel side by side in regular layers or strata, we say they chamber; but if they are a little too large for this, so that some of the shots must lie above the common level for want of space between other shots and the side of the bore to admit of their going down, we say the gun will not chamber shot of that particular size. A gun is not supposed to shoot shot to perfection which she cannot chamber.

Charger.—A small measure employed for measuring powder in loading a gun or cartridge-shell.

Chequer-work.—The chequered carving as made on the stock of a gun.

Cherry-mould. A small spherical cutting-tool, used for enlarging the interior of bullet moulds. It may be bought of houses dealing in gunsmith's materials, or it may be made by dressing a piece of soft steel down to proper shape, cutting file-teeth upon it and then hardening in the usual way. To use the cherry, close the mould upon it and then turn it round and round until the interior of the mould is cut out to the required size and shape.

Cherry Tree.—A North American tree, growing to about medium size and furnishing a hard, reddish and most beautiful wood, highly prized for fine gun stocks. It is now getting to be quite scarce. Botanical name, *Cerasus serotina.*

Choke-bore.—A gun-bore slightly larger at the breech than at the muzzle.

Choke-dressing.—Dressing out the bore of a gun so as to make it slightly larger at the breech than at the muzzle.

Clamp, Mainspring.—A mainspring clamp is a kind of vise used by gunsmiths for clamping the mainspring preparatory to taking it from the lock.

Cock.—In flint-lock guns, that part of the lock which holds the flint. The name is also often applied to the hammer of percussion and other locks of more modern make. When the hammer has been pulled back to its last catch, we say the gun is cocked, or at full-cock; when pulled back to the catch next preceding the last, we say the gun is half-cocked, or at half-cock.

Comb.—That portion of the stock upon which the cheek rests at the time of firing.

Cone.—See Nipple.

Counter-sink.—The recess in the chamber in which the rim of the cartridge fits.

Cross-Fire.—We say a rifle "crosses fire" when it plays the balls on the same level without varying upward or downward.

Curled Maple.—This is not a species of growth, but an unexplained condition to be met with in the wood of the maple, most commonly in that of the sugar or hard maple (the *Acer saccharinum* of botanists), though occasionally in *Acer rubrum*, or red maple. The grain of the wood lies in regular waves, presenting a most beautiful appearance when nicely dressed up. It is very popular for fine gun stocks.

Cylinder.—That part of a revolver in which the charges are placed. In the older make of percussion lock guns a short plug screwed into the side of the barrel at the breech, in which was placed the cap-tube or nipple, and through which the fire from the cap was communicated to the charge.

Damascus.—The variegated appearance on gun barrels, produced by welding together metals dissimilar, as steel and iron, and then, while heated, twisting these metals into various tortuous forms and re-welding. The colors of the dissimilar metals are brought out by browing mixtures.

Direct Fire.—That arrangement in a breech-loader by which the plunger lies and strikes the ignition horizontally.

Dog.—That part of the gun-lock acted upon by the trigger to release the tightened mainspring and set the hammer in motion. Earlier gunsmiths called it by this name, but it is now usually called the sear.

Double Triggers. Often called set-triggers. A pair of triggers arranged to a rifle, occasionally, to

admit of setting it off with but slight pressure. The triggers are located one in advance of the other under the guard. To operate pull upon the rear one until it "clicks" and is "set," after which cock the gun. The slightest pressure upon the front trigger springs the "set," which acts suddenly upon the sear, releasing the mainspring.

Drop.—Distance measured from the top of the butt of a gun stock to a line drawn rear-ward from the top of the barrels, usually from 2 to 3½ inches.

Elevated Rib.—The raised rib on top of and between the barrels of a shot gun.

Escutcheons.—Pieces of metal, through which the bolt to hold the barrel to the stock, is passed.

Extractor.—An automatic working rod in central fire guns, by which the empty cartridge is partly withdrawn from the chamber.

False Breech.—A piece of iron permanently screwed to the stock to fit squarely against the breech of the barrel. In the modern muzzle-loader the barrel is secured against it by hooks. It is also called a patent breech, also a standing breech.

Fastenings.—Mechanism for holding the barrel of breech-loaders securely to the frame or action when the barrel is in position for firing.

Flash.—In the days of the old flint-lock a gun was said to "flash" when the priming ignited in the pan but failed to fire the charge.

Flux.—A substance or mixture used to facilitate the melting of metals or minerals, as glass, borax, and the like.

Fore Piece.—That portion of the stock lying under the barrel, forward of the lock, called also fore-end and fore-arm.

Fore Sight.—The sight located nearest the muzzle end of the barrel.

Forge.—A furnace with its accompaniments where iron or other metals are wrought by heating and hammering. When a piece of metal is hammered into some required shape, the operation is termed "to forge it."

Fowling Piece.—A smooth bored gun, used for hunting small game, shooting shot or small pellets.

Freeing.—Slightly enlarging the bore of a gun at the muzzle.

Frizzen.—In the old flint-lock the steel plate that covers the pan and stood up in front of the flint, against which the flint struck to produce fire to ignite the priming.

Grip.—A name usually applied to the round part of a gun stock just back of the locks. It is also applied to the handle of a pistol.

Guard.—The piece of metal which curves around the triggers and protects them.

Half Stock.—A gun stock that does not extend the full length of the barrel.

Hammer—That part of the gun-lock that strikes the plunger or cap, or other form of ignition. See cock.

Hammer-Gun.—A gun whose lock works with a hammer.

Hammerless Gun.—A gun whose arrangements for setting off the ignition are contained inside the breech mechanism, and not visible when the arm is ready for use.

Handle.—See grip.

Hazel Nut.—A small shrub growing abundantly in many portions of the United States. The *Corylus* of botanists, divided into two species, *Americana* and *Rostrata*.

Head.—In a gun stock, the part where the breech end of the barrel rests against.

Heel Plate.—The metal piece terminating the breech end of a gun stock

Hind Sight—The sight upon the barrel, nearest the breech.

Hinge Pin.—A pin fixed in the action on which the barrel plays.

Ignition.—Any chemical combination which can be caused to explode and fire the charge, as in a cap or cartridge, for instance.

Kentucky Rifle.—A form of rifle once very popular with Western hunters, and now used to some extent. It is muzzle loading, and the great length of the barrel was one great peculiarity.

Kick.—When a gun rebounds at firing the term is used "it kicks."

Land Space.—The space in the bore of a rifle between the grooves.

Lever.—The bar or rod the working of which locks or unlocks the action of a breech-loader, enabling the operator to open or close the gun. As top-lever, side-lever, under-lever, etc.

Lock Plate.—The flat plate to the inside of which all the other parts of the gun lock are secured.

Loop.—The projection under the barrel to which the fore end is fastened. See barrel loop. They are of two kinds, wire and bolt loop.

Long Fire.—When a noticeable space of time intervenes between the striking of the hammer and the explosion of the charge, hence the term, the gun has made "long-fire."

Lower Rib.—The rib underneath and between the barrels of a shot gun.

Lump.—The iron piece soldered to the barrel of a breech-loader, which descends into the action and is there secured preparatory to firing.

Magazine Rifle.—A rifle provided with an interior magazine for containing cartridges, and so made that they are passed automatically into a chamber ready for firing.

Mainspring.—The large spring in the gun-lock which imparts action and power to the hammer.

Monocular Vision.—Seeing with only one eye. When one eye is closed, as some do in taking sight with a gun, it is a case of monocular vision.

Mould.—An implement for moulding bullets. The plural form is generally given to it, as bullet moulds.

Musket.—A form of gun, smooth bored and formerly used for military purposes. When grooves are cut in the interior of the barrel, it is called a rifle.

Nipple.—In a percussion-lock gun, the tube upon which the cap is placed. In the central-fire breech-loader, the tube through the standing breech in which the striker or plunger works.

Nipple Wrench.—An implement used for screwing the nipples into position or out. It is often called a tube wrench

Oblique Fire.—Indicates that the plungers of a breech-loader lie and strike the ignition obliquely.

Pan.—A small pan-like outside on the flint-lock, which holds the priming, and in which the latter is ignited by a spark from the flint striking the frizzen.

Patent Breech.—See false breech.

Pepper Box Pistol.—One form of revolver pistol, in which the barrels are made full length from one piece of metal. The rotation of the barrels and the action of the lock to fire the arm was produced by pulling the trigger.

Picker.—A small wire implement hung to the shot-pouch of the hunter in the days of the old flint-lock, and used when occasion required for picking priming into the touch hole of the gun.

Pipes.—Short tubes attached to a barrel or to a rib attached to the barrel to receive the ramrod and hold it in place.

Pistol.—A small variety of fire-arm, so made as to be easily carried in the pocket or a holster, and readily manipulated and fired with one hand.

Pistol Grip.—A gun stock whose grip inclines to turn down like the handle of a pistol, is said to have a pistol grip.

Play.—A rifle which does not shoot with regularity is said to play its balls.

Plungers.—The pins which are struck by the hammers, in breech-loaders, and which in turn strike and explode the ignition.

Powder Bed.—The chamber, in a muzzle-loader, where the powder lies when the gun is charged.

Priming.—The powder in the pan of a flint-lock gun.

Proof Marks.—Impressions of stamps made in gun barrels to indicate that they have been proved.

Proving —Firing gun barrels with very heavy charges of powder and balls to ascertain if they are of proper strength

Ramrod —A rod with which the tightly fitting portions of the charge are pushed home in loading a muzzle-loader.

Rebounding Lock.—A lock which has the top of the mainspring and crank of the tumbler lengthened to such an extent that when the trigger is pulled the hammer delivers its blow and immediately rebounds to the half-cock.

Rib.—The metallic strip lying between and connecting the barrels of a shot-gun. See lower rib and upper rib.

Rifle.—A gun having grooves cut parallel with each other along the interior of the barrel. They usually take a more or less spiral course for the purpose of imparting to the bullet thrown a whirling or twisting motion on its flight through the air. The grooves thus cut are sometimes called rifles.

Rifle.—A gun with grooves cut in a twisted or spiral-like manner on the interior of the barrel, for the purpose of giving the projectile a rotary motion on its axis during its flight. The design being to give greater accuracy to the course of the bullet.

Rifle Cane.—A metallic walking staff, which is virtually a rifle, capable of shooting with much force. The lock works internally, and everything is so arranged as to pretty effectually conceal the true character of the arm, it, at a casual glance, presenting only the appearance of a neat walking-stick.

Rifle Guide.—An implement used by the gunsmith to guide the course of his rifle-saws in cutting grooves in the bore of a barrel.

Rifle-Saws.—Short files made to fit in the grooves of a rifle. They are usually attached to a rod, near the end, and drawn to and fro through the gun for the purpose of filing the grooves down to greater depth, where such a thing is required. In cases where new grooves are to be cut in a smooth-bore, the rod passes through a rifle-guide, which forces the saws to take the proper twist through the barrel.

Rim-Fire.—A cartridge whose ignition is around the rim instead of in the centre, and which, consequently, can be used only by some arm striking the cartridge at the rim.

Rouge.—A fine powdery material, used for putting a high polish upon the surface of well-finished metals. It is usually applied by rubbing in connection with soft leather, either in the form of a buff or otherwise.

Saturated Solution.—A liquid holding in solution as much of some particular soluble chemical as it will dissolve. For instance, if salt be put in water until a portion remains undissolved at the bottom of the vessel, there is in the liquid a saturated solution because it holds in suspension all the salt that it can dissolve.

Scatter.—When a shot gun throws the pellets over a range of space unusually wide, it is said that it scatters.

Scroll Guard.—An extension downward from the trigger guard, to steady the hand. It is designed to answer the same as pistol grip.

Sear.—Sometimes called dog, which see.

Sear-Spring.—The small spring in a gun-lock which presses the sear into the notches of the tumbler.

Set-Triggers.—See double-triggers.

Side-Lever.—A lever which works at the side of a breech-loader.

Side-Screw—The long screw holding the lock to the stock.

Slack-Tub.—A vessel containing cold water, to be used in suddenly cooling hot metals, as in hardening steel, for instance.

Smooth Bore.—A gun for throwing single bullets, made on the plan of a rifle, but having no grooves in the bore. It is sometimes called a "smooth-bore rifle."

Standing Breech.—See false breech.

Steady-pin.—The small projection on the mainspring which fits into the lock-plate.

Strap.—The metal strip in a breech-loader which runs from the breech-works down the stock, in place of the tail, or the old fashioned breech-pin.

Strikers.—See plungers.

Sugar Maple.—A tree indigenous to the United States, whose wood is extensively used in the manufacture of gun-stocks. See curled maple.

Swivel.—The small piece in a lock connecting the tumbler and the mainspring.

Tear.—When a bullet makes a hole larger than its own diameter, particularly in the flesh of an animal, the gun from which it was shot is said to tear.

Tenons.—Iron projections on the lump of a breech-loader, to fit into corresponding spaces in the action.

Thimbles.—The metallic loops on the under side of a muzzle-loader, made to hold the ramrod when not in use.

Toe.—The extremity of the breech which rests nearest the armpit when in the act of taking off-hand aim.

Top Lever.—The lever of a breech-loader, which works on the upper side of the gun, just back of the hammers.

Trigger.—The small lever under the gun, upon which is pressed with the finger to release the confined mainspring and allow the hammer to descend.

Trigger-Plate—The iron plate in which the trigger works.

Trigger Spring.—A small spring to keep the trigger pressed close to the sear.

Tube.—The modern gunmaker calls the gun-barrel a tube; in old times the only tube known to the gunsmith was that projection upon which the percussion cap was exploded. See nipple.

Tube.—See nipple.

Tumbler.—That part of the lock directly connected with the hammer, and in which are the two set notches.

Tumbler-Screw.—The screw on the outside of the lock, passing through the hammer and holding it securely in its connection with the tumbler.

Upper Rib.—The rib above and between the barrels of a double-barrel shot-gun.

Vent.—A small hole in side of the gun breech communicating with the interior or powder chamber.

Vise.—An implement for clamping or holding.

White Maple.—The *Acer dasycarpum* of botanists—a near relative of the sugar maple. Common in many parts of the United States. Called soft maple in some localities.

Whole-Stock.—A gun-stock extending the entire length of the barrel.

Wiper.—A long ramrod used only in wiping out and cleaning the bore of a muzzle-loader. Also a small spiral implement made to screw on the end of a ramrod for the purpose of boring into and drawing a wad from a gun, or for holding material for wiping. Sometimes called a wormer.

Wormer.—See wiper.

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VOCABULARY OF CHEMICALS AND SUBSTANCES USED IN VAR[redacted] .....

CHAPTER XL.

VOCABULARY OF CHEMICALS AND SUBSTANCES USED IN BROWNING, VARNISHES, &C.

Acid, Gallic.—Acid produced in yellowish colored crystals, derived from nut-galls or oak apples. Soluble in water and alcohol. Nut galls are an import ingredient in the manufacture of good black ink.

Acid, Muriatic.—Called also Hydrochloric Acid and sometimes spirit of salt. Made by the action of sulphuric acid on common salt (chloride of sodium). Mingled with half its volume of Nitric Acid it forms Aqua Regia.

Acid, Nitric.—Sometimes called Aqua Fortis. Made by the decomposition of Nitre, or saltpetre by strong sulphuric acid.

Acid, Sulphuric.—Called oil of vitriol, made from sulphur and nitre or saltpetre.

Acid, Hydrochloric.—Called Muriatic Acid, which [redacted]

Alcohol.—The product of the fermentation of sugar, and is contained in all fermented liquors. It is a colorless fluid, boils at 173° F. and burns without smoke. The volatile oils and resins are dissolved by it, as well as many acids and salts, the caustic alkalies, etc. The resulting compounds of the acids upon alcohol are called ethers.

Alkanet Root.—The root of a species of Bugloss. It affords a fine red color to alcohol and oils, but a dirty red to water. The spirituous tincture gives to white marble a beautiful deep stain.

Annatto.—Also spelled Anotta and Anotto. A red coloring substance obtained from the pulp of the seed-vessel of the plant *Bixa orellana*. It dissolves better and more readily in alcohol than in water.

Antimony, Chloride of.—Called also Butter of Antimony and Sesquichloride of Antimony. Made by distilling the residue of the solution of sulphuret of antimony in strong hydrochloric acid, or by distilling a mixture of corrosive sublimate and antimony. It is highly corrosive. In medicine, used as a caustic.

Antimony, Butter of.—See Antimony, Chloride of.

Aqua Fortis.—Called also Nitric Acid, which [redacted]

Aqua Regia.—Made by mixing one part nitric acid in two muriatic acid, by measure; keep the mixture in a bottle in a cool, dark place.

Asphaltum.—Native bitumen, will dissolve in turpentine with gentle heat.

Benzoin, Gum or Gum Benjamin.—A gum extracted from the tree, *Styrax benzoin*, which grows in the East Indies. It fuses at a gentle heat, can be dissolved in alcohol and imperfectly dissolved in ether. It is employed as a varnish for toilet and other articles, which give out an agreeable smell when warmed by the heat of the hand.

Blue Vitriol.—Sulphate of copper. A salt formed by sulphuric acid in combination with copper. It is soluble in cold or warm water, used much in dyeing and exciting galvanic batteries.

Brimstone.—See sulphur.

Brimstone, Black.—Crude sulphur.

Burnt Umber.—Umber is a mineral of brown color from the Island of Cyprus. Two kinds are found in the market, raw and burnt.

Butter of Antimony. See antimony, chloride of.

Camphor.—A solid concrete substance, *Laurus camphor* or Indian laurel tree, which grows in the East Indies, China and Japan. Soluble in alcohol, ether, oil and acetic acid.

Chloride of Antimony.—See antimony, chloride of.

Chlorids of Mercury —Called corrosive sublimate, which see.

Chloride of Iron.—See muriate of iron.

Copal.—The concrete juice of a tree growing in South America and the East Indies. Strictly speaking, it is not a gum or a resin, but rather resembles amber. It may be dissolved by digestion in linseed oil with heat little less than sufficient to boil the oil. The solution, diluted with oil of turpentine, forms a transparent varnish. It also dissolves in ether, and the ethereous solutions may be mixed with alcohol.

Copperas.—Sulphate of iron or green vitriol. A salt made by the decomposition of iron or iron pyrites in oil of vitriol. Dissolved in water, is the basis of black dyes, and is used in making ink, &c.

Copper, Sulphate of.—Called blue vitriol, which see.

Corrosive Sublimate.—Chloride of mercury. A salt prepared by the decomposition of sulphate of mercury by common salt. It is a deadly poison. It is soluble in alcohol, ether, in two or three parts of hot water and in about 15 parts cold water. It melts and sublimes about 600°. The white of eggs is an antidote for the poison.

Damar or Dammar.—A gum obtained from the agathis or dammar tree, allied to the pine trees, growing in the East Indies. It is soluble in alcohol and in oil of turpentine.

Dragon's Blood.—The inspissated juice of various plants, of a red color, used for tinging varnishes, tooth tincture, staining marble, &c.

Ether, Nitric.—Mode of distilling equal parts of strong nitric acid and alcohol with a few grains of urea. It is liquid, colorless, of sweet taste, and insoluble in water. It boils at 185° F. The vapor explodes at moderate heat.

Elemi.—A resin obtained from plants grown in the East Indies and South America. In making lackers, it is used to give toughness to the varnish.

Fustic.—The wood of a tree growing in the West Indies. Used for dyeing yellow.

Gallic Acid.—See Acid, gallic.

Green Copperas.—Sulphate of iron. See Copperas.

Green Vitriol.—Copperas, which see

Hydrochloric Acid.—Muriatic Acid, which see

Iron, Chloride of.—See Muriate of Iron.

Iron, Muriate of.—See Muriate of Iron.

Iron, Sulphate of.—See Sulphate of Iron.

Iron, Sesqui-Chloride of.—Perchloride of iron or permuriate of iron. Made by dissolving rust of iron in muriatic acid and then crystalizing. It forms red crystals. Soluble in water, alcohol and ether. Very corrosive.

Logwood.—The wood of a tree growing in Central America. The extract is used in dyeing black color.

Madder.—A plant of the genus Rubia, one species of which is used in dyeing red.

Manganese, Sulphate of.—A beautiful rose-colored salt, used to give a fine brown dye.

Mastic.—A resin exuding from the mastic tree. It is in yellowish-white, semi-transparent tears. Used as an ingredient in varnishes.

Mercury, Quicksilver.—A metal fluid at ordinary temperatures. Congealable at about 40° below zero. Boils at 660° and forms a colorless dense vapor. It is used in barometers and thermometers, and in alloy with tin in coating mirrors. It unites with chloroform, forming calomel and corrosive sublimate. The only acids that act on it are sulphuric and nitric. To unite with the latter it must be heated.

Mercury, Chloride of.—See Chloride of Mercury.

Mercury, Horn.—Called Chloride of Mercury.

Mercury, Muriate of.—Chloride of Mercury.

Muriate Tincture of Steel —See Muriate of Iron.

Muriate of Iron.—Called Chloride of Iron. Made by dissolving iron filings in muriatic acid and crystalizing by evaporation. Crystals of green color being the result.

Nitrate of Silver.—Made by dissolving silver in nitric acid and evaporating the solution in crystals. Will dissolve in warm water. Is used for indelible ink to mark clothing and in photography. When fused and cast in small sticks is called lunar caustic.

Nitric Acid.—See Acid, nitric.

Nitric Ether.—See Ether, nitric.

Oil of Vitriol.—See Acid, sulphuric.

Pearlash.—Carbonate of potassa. An alkali obtained from the ashes of trees by leaching. When evaporated to dryness in iron kettles it is called potash, but when calcined to burn off the coloring matter it is called pearlash.

Potash.—See Pearlash. Sometimes called salts of tartar.

Pumice Stone.—A substance resembling the slag from furnaces, ejected from volcanoes. The pulverized material is used to remove the gloss and imperfections on varnished surfaces by rubbing with a woolen cloth and water.

Quicksilver —See Mercury.

Rotten Stone.—A soft stone used for fine grinding and polishing. Generally used after pumice stone, and is applied with a soft woolen cloth and sweet oil.

Salts of Tartar.—See Potash.

Sandarac.—A resin that exudes from tree growing in Africa. Fusible by heat and soluble in alcohol. Used in varnishes.

Sesqui-Chloride of Iron.—See Iron, Sesqui-chloride of.

Shellac.—Lac is a resinous substance produced mainly from the banyan tree of the East Indies. It is the product of an insect. Stick lac is the resin in its natural state; seed lac when broken up, cleaned of impurities and washed; shellac when it is melted and formed in thin flakes. United with ivory-black or vermilion it makes sealing wax.

Dissolved in alcohol it makes lackers and varnishes.

Silver, Nitrate of.—See nitrate of silver.

Soda.—Common. See potash.

Spanish Whiting.—Ground chalk carefully cleaned from all stony matter

Spirits of Nitre.—An alcoholic solution of nitrous ether.

Steel, Tincture of.—See muriate tincture of steel.

Sulphate of Iron.—Copperas or green vitriol. See copperas.

Sulphate of Manganese.—See manganese, sulphate of.

Sulphur.—Often called brimstone. A mineral of yellowish color. Soluble in turpntine, fat oils, bisulphuret of carbon and hot liquor of potassa. With oxygen it forms sulphuric and sulphurous acids, and with the metals it combines as sulphurets or sulphides. It is an essential ingredient in gunpowder, and the gas arising from its combustion is employed in bleaching straw and woolen goods.

Tartar, Salts of.—See potash.

Turpentine.—An oleo-resinous substance as flowing from several species of pine, larch and fir trees. Oil of turpentine is obtained by distilling the crude turpentine.

Umber, Burnt.—See Burnt Umber.

Venice Turpentine.—A liquid resin which exudes from the larch tree. The Venice turpentine usually met with is turpentine to which is added a quantity of black melted resin.

Verdigris.—A green oxide of copper, very poisonous. The white of eggs is an antidote for the poison, when taken into the stomach.

Vitriol, Blue.—Called sulphate of copper. See Blue Vitriol.

Vitriol, Green.—Sulphate of iron. See Copperas.

Vitriol, Oil of.—See Acid, sulphuric.

Whiting, Spanish.—See Spanish Whiting.

CHAPTER XLI

CALIBERS OF GUNS RIFLING, TWIST OF RIFLING, ETC. . . . .
European Guns. . . . . .
American Guns. . . . . .
Pistols. . . . . .

CHAPTER XLI.

CALIBERS OF GUNS, RIFLING, TWIST OF RIFLING, ETC.

European Guns.—The Enfield Rifle; Muzzle Loader, Cal. 577; 3 grooves; regular twist, slightly deeper at breech than at the muzzle; rifling one turn in 6 feet 6 inches.

The Purdy Rifle, Muzzle Loader; Cal. 650; 4 grooves; increasing twist, commencing at one turn in 6 feet and ending at one turn in 4 feet 9 inches.

The Wilkinson Rifle, Muzzle Loader, Cal. 530; 5 grooves with a regular twist of one turn in 6 feet 6 inches.

The Lancaster Rifle, Muzzle Loader. Bore smooth and elliptical diameter at muzzle; greater axis, 550; lesser axis, 540; greater axis at breech, 557; lesser axis, 543. The twist is one quarter turn in whole length of barrel. Length of barrel, 39 inches.

The Snider Rifle, Muzzle Loader; Cal. 577; 5 grooves, one turn in 4 feet.

The Whitworth Rifle, Muzzle Loader Polygonal or hexagonal form of bore. Rifling, one turn in 20 inches. Bore, 564 across the flats. 568 across center of flats.

The Jacobs Rifle, Muzzle Loader; 4 grooves; lands and grooves equal. Rifling four-fifths turn in 24 inches.

The Turner Rifle, Muzzle Loader. Bore, 588 Rifling Turner's Patent, one turn in 4 feet.

The Rigby Rifle, Muzzle loader. Rifling 6 grooves, one turn in 4 feet.

The Boucher Rifle, Muzzle Loader. Bore hexagon with angles, rounded off so as to form shallow grooves, 608 deep in center. Bore, 570. Rifling one turn in 3 feet 3 inches.

The Prussian Needle Gun, Breech Loader. Rifling 4 grooves, one turn in 40 inches.

The Chassepot Rifle, Breech Loader, Cal. 433; rifling 4 grooves, turning from left to right, one turn in 21½ inches.

The Snider-Enfield, Breech Loader. Rifling 3 grooves slightly deeper at breech than at the muzzle, one turn in 78 inches. Diameter, 577. Depth of rifling at muzzle, 05. At breech, .13. Width of grooves three-sixteenths inch.

Westley Richard's, Breech Loader. Bore octagonal form. Rifling one turn in 20 inches.

Regulation Minie Rifle, Muzzle Loader. Rifling one turn in 6 feet 6 inches.

American Guns.—The Peabody-Martine Rifle, Breech Loader. Rifling 7 grooves, one turn in 22 inches, gain twist, lands and grooves of equal width.

Maynard Rifle, Breech Loader. Rifling 3 grooves, one turn in 5 feet, lands and grooves equal width; depth, .01.

Sharp's Rifle, Breech Loader. Lands and grooves equal width. Rifling one turn in 20 inches.

Bown & Sons' Kentucky Rifle, Muzzle Loader. Standard number of grooves 7, but made with 4, 5, 6, and 7 grooves, same width as lands. Even twist one turn in 42 inches. Gain twist commences at 9 feet and ends at 6 feet.

Powel & Son's Breech Loading Rifle, 6 and 7 grooves, one turn in 36 inches

Steven's Rifle, Breech Loader. Regular twist, one turn in 26 inches.

Springfield, U. S. Rifle, Breech Loader, Cal. 45 Rifling 3 plain concentric grooves. Lands and grooves equal width. Uniform twist, one turn in 22 inches, depth .005.

Frank Wesson's Rifle, Breech Loader. Long and mid-range guns using long slugs, even twist, one turn in 18 inches, grooves 6, lands and grooves equal width. Short range guns, using slugs having short bearing, increase twist commencing on 6 feet, and ending on 2 feet, 5 and 6 grooves, lands and grooves of equal width

Wesson's Muzzle Loading Rifle. Barrel 2′ 6″ long. Rifling one turn in 3′ 6″. 6 grooves; space between

grooves equal to interior surface presenting a dovetail appearance. Groves not so wide as spaces.

The Whitney Arms Co.'s Guns, Breech Loading, comprising the Whitney, Kennedy, and Phœnix systems. Rifling 6 grooves, one turn in 22 inches. Lands and grooves of equal width.

Marston's Rifle (Toronto, Canada), Muzzle Loader, number of grooves 6, lands and grooves equal width; regular twist, one turn in 30 inches; depth of groove 15-thousandths inch, slightly freed at breech.

Pistols.—Colt's Army Pistol, Breech Loading Revolver, Cal. 45. Rifling 6 grooves, twist uniform, one turn in 16 inches, depth .006.

Schofield, Smith & Wesson Revolver for Army Use, Breech Loader. Bore, .435. Number of grooves 5, uniform twist, one turn in 20 inches. Depth of rifling .0075.

CHAPTER XLII.

DIRECTIONS FOR TAKING APART AND ASSEMBLING GUNS, RIFLES AND PISTOLS. .. ..

Rifles ....
The Ballard Rifle ... ...
The Burgess System ... ...
Burnside's Rifle. .. . .
The Evans Rifle . ...
Hotchkiss Repeater ... .
Howard's "Thunderbolt" ... .
The Kennedy Magazine Rifle.. ....
Martin Repeating Rifle ....
The Maynard Rifle ... .
Peabody Martini Rifle ... ...
The Phœnix ....
The Remington System .. ..
Remington Magazine Gun (Keene's Patent).....
Remington No 8 (Hepburn's Patent)..... .. ..
Sharp's Rifle . . . .
United States Muzzle-Loading Rifle and Musket.. .....
Springfield Breech Loading Rifle. ....
Whitney Breech-Loading Gun . .. .
Whitney New System Breech Loading Gun..... ....
Winchester Magazine Gun .. ..
Billings' Breech Loading Shot Gun .. ..
Fox Breech Loading Shot Gun . . ..
Lefevre Hammerless Gun. . . . .
Parker Double Barreled Breech-Loading Shot Gun-. ...
Remington Double Barreled Breech-Loading Shot Gun. .
Roper Four-Shooting Shot Gun and Rifle..... ....

CHAPTER XLII.

DIRECTIONS FOR TAKING APART AND ASSEMBLING RIFLES, DOUBLE-BARRELLED SHOT GUNS AND PISTOLS, OF THE MOST NOTED MAKERS IN THE UNITED STATES.

The Ballard Rifle.—(Made by the Marlin Arms Co., New Haven, Conn).

To Take Apart.—1, take the sight from the barrel; 2, take off the stock by unscrewing butt-plate; and turning out the long tang screw; 3, drop the lever and take out lever screw; take out the extractor then the block; 4, unscrew the barrel from the frame and take the tang from the frame; 5, take the screws from the lock and pry the plates apart.

To Assemble.—Proceed in reverse order.

The Burgess Repeating Rifle.—(Made by Whitney Arms Co., New Haven, Conn).—1, receiver; 2, bottom tang; 3, lever; 4, breech-block; 5, top lever; 6, ejector; 7, carrier-block; 8, bottom plate; 9, bottom plate snap; 10, hammer; 11 main-spring; 12, hammer-screw; 13, side loading spring cover as seen from the back; 14, trigger.

To Take Apart - 1st, take out the bottom plate screw, and remove the plate; 2d, take out the top cover screws and slide the cover back against the hammer, having depressed the lever sufficiently to let it pass by, then pull back the hammer as far as possible and take the cover out; 3d, take out the carrier screws, there being one on each side of the upper rear portion of the receiver, and the stop screw on the upper front left hand side of the receiver, then the lever, breech-block, extractor and carrier can be taken out through the top.

To Disengage the Lever from the Breech Block.—Take out, 1st, the firing pin screw; 2d, the firing pin; 3d, the ejector from the side of the breech-block; 4th, the large pin from either side. In assembling, replace the pin in exactly the same position it was when taken out.

To Assemble.—1st, place the lever, breech block, extractor and carrier in their proper position, relatively to one another, as they were when taken out. with the projection on the breech-block inside, and under the front part of the carrier. 2d. Replace the above parts taken together in the receiver, passing the handle of the lever first through the top, put in the carrier side screws and the stop screw. 3d cock the hammer, slide the top cover into place, the breech being left half way open, then put in the screw; 4th, close the breach and screw the bottom plate to place.

Burnside's Breech Loading Rifle.—To clean the gun, unlatch the guard and drop the chamber; press down the small spring bolt at the guard joint with the finger nail, while the lever of the joint-bolt is turned out of place and taken from the joint. To detach the movable breech pin from the chamber, press it back with the thumb and forefinger of the left hand; hold the bolt in this position with the thumb nail of the right hand inserted in the notch of the bolt, while with the fore finger of the same hand, the breech-pin is pushed into the chamber, and the head or button of the spring-bolt is turned from its place, when the breech-pin may be removed. Every part of the arm, except the lock is now exposed to view. Put together in reverse order of taking apart.

The Evans Magazine Rifle.—(Made by the Evans Magazine Rifle Co., Mechanics Falls, Me.; Mervin, Hulbert & Co., agents, New York City.)—To load the magazine, introduce the cartridge through the opening in the butt plate. Each complete movement of the lever forward carries the cartridge to its chamber. Repeat the motion till the magazine is full.

To use as a single loader, drop the lever to right angle with the barrel and insert the cartridge directly in the chamber.

The full motion of the lever forward discharges the empty shell, the return places the loaded cartridge in position, when the arm is ready for discharge.

Semi-Hammerless.—The American Arms Company are now producing a gun at a low price called the semi-hammerless single gun, for which the manufacturers claim that it combines the advantages of a hammerless without the danger of the self-cocking principle. To cock the gun press down the little lever on the side. The lock-plate is easily removed

to get at and oil the lock. Its construction is such that no water or dirt can penetrate to the lock.

The Hotchkiss Magazine Gun.—(*Made by Winchester Arms Co., New Haven, Conn.*)—To remove the magazine cut off, turn the notched end to the front; place the point of a screw-driver under the rear end and bear down gently, slightly supporting the front end against the pressure with the fingers of the left hand. To remove the breech-bolts press on the trigger and at the same time unlock the bolt and withdraw it. N. B.—The bolt can be removed in the following manner: unlock and draw back the bolt until the cocking piece just clears the receiver; then, letting go the handle, take hold of the cocking piece and turn it down to the right until the projection on the bolt-head leaves the groove under the front end of the locking-tube. The latter may then be drawn out at the rear, and the head at the front of the receiver. To return the bolt, the head must be inserted from the front and the part from the rear, unless the cut-off be removed

To remove the magazine-spring and cartridge-follower, insert the point of a screw-driver in the hole at the rear of the magazine tube, and draw out the tube. The barrel cannot be removed until the magazine has been taken out. Remove then the trigger spring screw and spring, the cartridge stop pin and stop, the trigger pin and trigger using a punch to drive out the pin. Remover the trigger catch pin and catch, using the point of a screw-driver in the notched end of the pin to draw it out.

To dismount the breech-bolt, remove the bolt-head, which can be done by holding the cocking-piece firmly in the left hand, and with the right turn down the handles as in the act of locking the bolt; the head will then slip off. Turn out the firing-pin screw; slip the bolt-head partly on the projecting end of the firing-pin, and use it as a wrench to unscrew the pin; the main-spring may then be removed. Remove the extractor by tapping gently on its projecting end with a piece of wood.

To assemble, proceed in the reverse order.

Howard's Sporting Rifle, "The Thunderbolt."—To clean the lock, take out the screw that attaches the back end of the yoke to the breech piece; unscrew the barrel; then take the nut from the back end of the sliding breech pin, which with the mainspring and hammer, constitute the lock

In using, if the operator does not wish to have the piece cocked, he has only to hold the trigger back while closing the guard, and it will not be cocked. To cock it from this position, he has only to open the guard a short distance, and close it. If he wishes to load and fire rapidly, it will cock itself. If in no haste, or does not wish it cocked, he has only to hold back the trigger, while closing its guard.

The Kennedy Magazine Gun. –(*Made by Whitney Arms Co., New Haven, Conn.*)—Directions for taking apart :

1 Take out the two side screws, on the left side of the receiver, that are nearest together. 2. Remove the bottom plate and carrier block through the bottom of the receiver. 3. Full cock the hammer and take out the extractor screw from top cover, then depress the lever sufficiently to let the cover pass over it, pull back the hammer as far as possible and slide the cover out over it. 4. Remove the breech-block and lever together through the the top of the receiver.

To disengage the breech-block: 1. Take out the firing-pin screw. 2. The firing pin. 3 The ejector from the side of the breech-block. 4. The large pin from either side.

To assemble, put the parts together in reverse order from which they were taken out.

Marlin's Magazine Rifle—(*Made by Marlin Arms Co., New Haven, Conn.*)—Figure No. 1 shows the arm in a closed position. A, represents the Lever; B, the Bolt; C, Extractor; D, the Carrier Block; E, the Ejector; F, the Carrier Block Spring; G, the Hammer; H, the Trigger; I, the Firing Pin.

To take the action apart: 1. Take out the lever pin screw, and drive out the lever pin, allowing the lever to be removed. 2. Take out the tang screw (this allows the stock to be removed), hammer screw, and front pin that goes through trigger strap; now remove the trigger strap with lock work attached. 3. The bolt can now be slipped out.

To assemble the action, put the parts into the receiver in reverse order from that in which they were taken out.

Maynard Rifle, Self-Priming Model.—(*Made by Mass. Arms Co., Chicopee Falls, Mass.*)—To detach the barrel: Loosen the lever at its rear end and move it forward. There is a button that keeps the magazine closed; turn this button downward and forward as far as it will go; then pull it out as far as it will come; this will detach the lever from the breech-piece, so that it will come partly out of it; unhook the barrel, and the lever will pass quite out of the breech-piece. To attach the barrel reverse the operation.

To remove the nipple: On the left side, opposite the nipple, is the screw which fastens it; take out this screw; put a stick of hard wood in the screw-hole; strike the stick a little and the nipple will be driven out.

To dissect the rifle for a thorough cleaning: There are four screws on the under side of the gun, behind the hole where the lever is pivoted. Take out the two farthest back, and the stock may then be drawn back so as to separate it from the breech-piece.

To adjust the joint between the end of the barrel and the breech-piece: There are two screws visible on the under side of the breech-piece, forward of the lever. They are to adjust the joint to the thickness of the flange of the cartridge. To do this: First, turn the screw nearest the lever once round to the left; now raise the butt-end of the barrel, put in a cartridge, and observe as you bring the butt-end down again whether the joint is too close, so as to pinch the flange, or not close enough to hold it firmly. The exact degree of tightness allows the lever to work easily, but holds the barrel perfectly firm.

This degree will be found by turning the forward screw to the right or left. Having found this degree, turn the rear screw to the right, tightly, and the joint is adjusted

The Peabody-Martini Rifle.—(Made by Providence Tool Co., Providence, R. I.)—1. Butt Stock. 9. Stock Bolt. 10. Receiver, or Body. 11. Trigger Spring. 12. Screw for Locking Bolt Spring and Trigger Spring. 14. Stop Nut. 15. Block Axis Pin. 16. Striker, or Firing Pin. 19. Block. 25. Tumbler. 26. Indicator. 27. Block Lever. 28. Extractor. 29. Tumbler Rest. 30. Tumbler Rest Axis Screw. 31. Extractor Axis Screw. 32. Guard. 33. Trigger. 34. Trigger Axis Screw. 35. Swivel. 36. Swivel Axis Screw. 46. Barrel. 47. Fore, or Tip-Stock. 48. Cleaning Rod.

To dismount body or receiver: Turn keeper-screw so the groove in head will allow block axis pin to drop out; open the breech, and with the thumb press with force on front end of block, and, at the same time, raise the lever; turn the keeper-screw so as to allow the tumbler axis to be pushed out. This also relieves the tumbler. Take out extractor axis screw.

To assemble body: Put lever back to its place in assembled guard and insert both in the body. Drop in extractor and turn in extractor axis screw. Put tumbler in place and put in tumbler axis, point upright and secure keeper screw. With the right hand raise the lever so as to touch the lever catch, then, with the first finger, pull the trigger back, and with the thumb push the trigger axis forward, and drop in the assembled block, the front end entering first. Apply a little force to back end of block with the left hand, moving the lever a little at the same time with the right hand, and the block will drop into place. Insert block axis pin and secure it with the keeper screw.

To dismount guard: Take out tumbler rest axis screw, relieving tumbler rest. Take out trigger spring screw, relieving trigger spring and locking bolt spring. Take out trigger axis screw, relieving trigger. Take out locking bolt screw, if found necessary.

To assemble guard: Hold trigger in place and turn in trigger axis screw. Restore locking bolt and thumb piece to place and turn in screw. Restore locking bolt spring and trigger spring and turn in trigger spring screw. Insert tumbler rest and turn in tumbler rest axis screw. The parts are now ready to be attached to the body, or receiver.

To dismount block: Turn keeper screw on end of block and take out stop nut. The firing pin and coil spring will then drop out.

To assemble block: Restore firing pin and coil spring. Turn in stop nut, and turn keeper screw to secure it.

The firing pin has a rectangular slot near one end. This slot is longer on one side than on the other. The long side should be so placed as to admit end of the tumbler freely.

The Phoenix Breech-Loader.—(Made by Whitney Arms Co., New Haven, Conn.)—No special directions are necessary for dismounting and assembling the Phoenix system. The breech block is taken out by loosening the screw that holds the pin, and then taking out the pin. After the breech-block has been removed let the hammer down as far as it will go, which relieves it from the pressure of the main spring, and it can then be easily removed by taking out the screw which holds it.

The Remington Breech-Loading Rifle.—(Made by E. Remington & Sons, Ilion, N. Y.)—Explanation of parts and technical names: A A. Receiver. B. Breech Piece. C. Hammer. D. Locking Lever. a. Main Spring. bb. Pins. c. Trigger. d. Lever Spring. e. Trigger Spring. f. Firing Pin. g. Extractor.

To remove the breech piece and hammer: Loosen the button screw until the button can be removed from the heads of the breech and hammer pins. Cock the hammer, push out the breech pin, take out the breech piece, let down the hammer as far as it will go (which leaves the main spring resting upon a stationary pin, and obviates the necessity of using a main spring vise in readjusting the parts). Remove the hammer pin and take out the hammer.

To replace the hammer and breech piece: Lay the arm down on the right side, press upon the trigger at the same time replacing the hammer with the thumb piece forward and downward, until the hole in the hammer and receiver correspond. Replace the hammer pin, cock the hammer, replace the breech piece, insert breech pin in receiver, and by pressing on the pin at the same time pressing down the breech piece and working it back and forth slightly the pin will enter. Adjust the button and tighten the button screw.

To take the entire arm apart: Take out the extractor screw, open the breech, remove the extractor, take out the breech piece and hammer, as described. In military arms remove the wiping rod by unscrewing the same, remove the bands, separate the tip stock from the barrel at the muzzle, until it is liberated from the stud upon the under side of the barrel, when it may be withdrawn from the receiver; take out the tang screw and remove the butt stock.

To detach the guard strap: Take out the two side screws which pass through the guard strap, always removing the rear screw first. Unscrew the barrel from the receiver, taking care that the extractor has been removed before unscrewing the barrel.

To assemble the arm: Screw the barrel into the receiver, until the mark on the top of the barrel and receiver correspond. Replace the extractor and screw, place the forward end of the guard strap in the receiver, putting in the screw. See that the main spring is in the center of the guard strap, press the rear end in until the screw will enter. Replace the hammer and breech piece, as previously described. Replace butt stock and tip. In putting on the bands of military guns, see that the letters upon them are upon the same side with the band springs. Replace the wiping rod by screwing it in.

The locking lever, attached to the guard strap, serves a double purpose: one end locking the sear, or trigger, when the breech is open to receive the

cartridge, which effectually prevents accidental discharge, the other end working in a groove on the under side of the breech piece, serving to close the breech piece and keep it closed in the act of firing.

The Remington Magazine Gun; Keene's patent.—(*Made by E. Remington & Sons, Ilion, N. Y.*) To remove the breech, turn the large screw at the right hand side of the stock below the hammer to the right until the carrier (which should be in its lower position at the time) drops free of the bolt and allows it to be withdrawn. N. B. The screw referred to is cut with a left hand thread. To separate the rear end of the bolt and firing pin from the front end, bend back the hammer and twist it around to the right until the shoulder on front end of rear cap slides back in the groove in breech bolt. To reassemble it reverse the operation described. To take out the extractor, press back the extractor bolt, using the hooked end of the screw-driver for this purpose, thus releasing the rear end of the extractor, which may then be lifted out of its seat. Care should be taken not to let the extractor be thrown out by the spring when released. To remove the stock, take off the bands; take out the screw at the end of the metal tip, and remove the tip-stock by slipping it forward over the magazine tube. Unscrew the magazine tube, take out the tang screw, remove the guard bow, and take off the butt stock. The barrel should never be unscrewed except with proper appliances to avoid injuring the receiver.

To assemble the parts, reverse the operations described, taking care in screwing in the magazine tube that the follower does not catch against the cut-off and interfere with replacing the tube.

Remington No. 3 Rifle,—(*Hepburn's Patent, made by E. Remington and Sons, Ilion, N. Y.*)—Remove the upper screw on the left hand side, and the breech block may be taken out. To take out the hammer, remove the upper screw and slip the hammer forward into the breech block hole. To take out the extractor, remove the forward screw on left hand side. The lever which operates the breech block passes through the rocker sleeve with a square stud and is held in place by a set screw directly under the fore stock, which must be removed if it is ever desired to take off the lever. If necessary to remove the guard it can be done by taking off the butt stock and taking out the side screws in the usual way. The barrel should not be unscrewed from the frame except with proper appliances. When necessary to unscrew the frame, the extractor should be taken out and the breech block and guard put back in place, before putting on the wrench.

Sharp's Rifle, (old model using paper or linen cartridge, also model of 1874 using metallic cartridge; made by Sharp's Rifle Co., Bridgeport, Conn.)—To take the arm apart: Relieve the lever key from pressure of spring by throwing down the lever guard, the key can then be taken out and the slide with lever guard attached, removed.

To replace, put slide in place, leaving guard down, then insert lever key, turning the key to place.

To take off the lock, give four or five turns to the side screws, tap their heads gently with the handle of the screw-driver to start the lock from its bed, the side screws can then be taken out and the lock removed. To replace the lock, press it firmly into its bed, before entering the screws and then turn them up close.

Sharp's Rifle, (Borchardt's Patent model of 1878; made by Sharp's Rifle Co., Bridgeport, Conn.)—Plate 3—AAA, receiver; BB, slide; CC, sear; D, firing bolt; E, cam; F, extractor; G, connection, H. trigger; K, safety catch, L, safety lever, MM, lever, NN, mainspring; O, lever spring; P, barrel stud; R, ramrod stop, military; S, ramrod, military; T, swivel, military; UU, barrel; VV, forearm, W, link; X, butt-stock bolt; 1, lever pin; 2, lever

To take the arm apart: Loosen the rear screw under the barrel, and this will relieve the pressure of the lever spring. Cock the gun by opening and closing. Bring down the guard lever half way Take out the lever pin on which the lever rotates This pin is held in place by a small screw directly above it. Turn this screw to the left until the circular cut in its side is on a line with the lever pin, and the latter can then be removed Pull lever out of the joint. Replace lever pin so as to hold extractor in place. Remove screw which connects lever and link, through hole in left side of link Take out lever. Push slide up and out, and then take out extractor.

To strip the slide, uncock it and push out sear pin and remove sear. Take out pin at rear end of slide. Take out slide plug and mainspring. Drive cross pin out of firing bolt and remove same. Remove link by taking last screw out of slide. To remove trigger, safety and safety lever, drive out trigger pin and safety pin above it. Pull back safety catch and pull out trigger. Push forward safety catch as far as it will go, and it will drop out, together with the safety lever above it.

To assemble, replace safety catch, safety lever and trigger. Assemble slide and cock it. Push safety catch into notch of triggur. Put in extractor and lever pin. Insert slide and push it down, keeping extractor close to its place, in base of barrel Attach lever. Take out lever pin, bring lever into the joint, replace the pin, and secure it by giving small screw above it half a turn to the right Tighten the screw which was loosened under the barrel.

Never use a hammer or other force either in taking apart or assembling this system. If the parts are in proper position, everything will go into place easily.

The U. S. Muzzle Loading Rifle and Musket —To take apart: Draw the ramrod; turn out the tang screw; put the hammer at half cock; partially unscrew the side screw, and with a light tap on the head of each screw with the handle of the screw-

driver or a light wood mallet, loosen the lock from its bed in the stock, then turn out the side screws and remove the lock with the left hand. Remove the side screws and take off the bands. Take out the barrel by turning the gun horizontally, barrel downward, holding the barrel loosely with the left hand below the rear sight, the right hand grasping the stock by the small, if it does not leave the stock, tap the muzzle on the top side against the work bench which will effect loosening it at the breech

To assemble, put together in the inverse order of taking apart. Squeeze the barrel in place with the hand; give the butt of the stock a gentle tap on the floor to settle the breech end of the barrel against the head of the stock

Springfield Breech Loading Rifle (made at Springfield, Mass. by U. S. Government; adopted by U. S. Government.)—A, Bottom of Receiver; B, Barrel; C, Breech Screw; E, Hinge Pin; F, Cam Lock; G, Cam Latch Spring; H, Firing Pin; I, Firing Pin Spring; J, Extractor; K, Ejector Spring and Spindle; L, ejector Stud; M, Lug of Extractor.

To dismount the breech loading parts: 1. Remove the hinge pin by pressing on its point with a small-sized punch until the end carrying the arm projects sufficiently to enable it to be grasped and removed by the fingers. 2. Remove the breech block carefully, so as not to allow the extractor and ejector spring to fall out. 3. Remove the extractor and ejector spring 4. Remove the cam latch by unscrewing the breech block cap screw, and loosen the cap with the point of a screw driver. 5. Remove the cam latch spring 6. Turn out the firing pin screw, then take out the firing pin and spring from the breech block

To assemble 1. Insert the firing pin screw in the breech block, then the firing pin, and then replace the firing pin screw. 2. Insert the cam latch spring in its place. 3. Replace the cam latch and the breech block cap; turn the cap screw well down. 4. Insert the ejector spring in its place. 5. Replace the extractor in such a position in the breech block that the small recess in the back of the extractor will be in a position to be presented to the point of the ejector spring spindle. 6. Insert the breech block. After seeing that the point of the spindle has entered the recess in the back of the extractor, strike the breech block over the thumb piece and head of the firing pin, a smart blow with the palm of the hand forwards and downwards, this will cause it to enter sufficiently to hold it in place Then press it into position by grasping the block and receiver with the fingers and thumb, the thumb uppermost, and squeeze it home. 7. Insert the hinge pin by striking it a sharp blow with the palm of the hand. See that the stud in the arm enters the recess cut for it on the side of the receiver.

Should the thumb piece interfere with the head of the hammer in raising the breech block, it is probable that either the tumbler or sear screw is too loose or broken.

Whitney Breech Loading Gun (made by Whitney Arms Company, New Haven, Conn.)—To take apart: 1. Give the screw in the side of the frame or receiver (that holds the two fulcrum pins) a few turns to release the flanges or heads of the two pins, then turn them away from the screw a little. 2. Place the hammer on the half-cock, open the breech half way, and press the locking shoulder back with the screw driver until it is held by the catch on the locking lever made for the purpose. 3. Knock out the pin that holds the breech block, and take out the breech block, lever and cartridge extractor at the same time. 4. Bring the hammer to full-cock, so as to release the locking shoulder, and then uncock it, pressing it forward so as to relieve the tension of the springs; knock out the large pin, and take out the hammer and locking shoulder together.

To assemble: 1. Draw back the trigger to its usual place and insert the hammer and locking shoulder (placed together, as when taken out) into the receiver, pressing them forward so as to relieve them from the tension of their springs; then insert the hammer pin, half-cock the hammer, and press back the locking shoulder until it is held by the catch on the locking lever. 2. Insert the lever, breech block and cartridge extractor placed together, put in the fulcrum pin, turn the heads or flanges of the two pins to their places against the binding screw, and turn it up to its place. 3. Open the breech in the usual way, or simply bring the hammer to full cock, when the locking shoulder will be released and the piece ready to operate. The ramrod is held in place by being screwed into the steel on the lower side of the barrel.

Whitney New System Breech Loading Gun (made by Whitney Arms Company, New Haven, Conn.)—1, Receiver or Frame; 2, Bottom Tang; 3, Barrel; 4, Breech Block; 5, Hammer; 6, Breech Block Fulcrum Pin; 7, Hammer Fulcrum Pin; 8, Extractor; 9, Mainspring; 10, Trigger; 11, Stud.

To take apart the lock work: 1. Give the screw in the side of the frame or receiver (that holds the two large fulcrum pins) a few turns to release the flanges or heads of the two pins, then turn them away from the screw a little. 2. Place the hammer on the full cock, open the breech half way, knock out the pin that holds the breech block and the extractor screw in the side of the receiver, then take out the breech block and cartridge extractor at the same time. 3. Uncock the hammer, pressing it forward so as to relieve the tension of the spring; knock out the large pin and take out the hammer.

To assemble the lock work: 1. Draw back the trigger to its usual place, and insert the hammer into the receiver, pressing it forward so as to relieve it from the tension of the spring; then insert the hammer pin and cock the hammer. 2. Insert the breech block and cartridge extractor, placed together, put in the fulcrum pin, turn the heads or flanges of the two pins to their places against the binding screw, and turn it up to its place; then put in the extractor screw.

Winchester Magazine Gun.—(*Made by Winchester Arms Co., New Haven, Conn.*)—To take apart:

To take out the barrel: Take out the two tip screws, the magazine ring pin, pull out the magazine tube, and take off the forearm; then, before unscrewing the barrel from the frame, the breech pin must be thrown back by moving the finger-lever forward, otherwise the attempt to unscrew it will break the spring catch that withdraws the cartridge, and ruin the breech-pin.

To remove the breech pin model of 1866: After removing the side plates and links, the spring catch must be next taken out, which is done by moving the breech-pin back so that the pin that holds the spring catch will be in a line with a corresponding hole through the frame; then with a small steel wire punch out the pin, then move the breech-pin forward and take out the spring catch; the piston can then be unscrewed with pliers or hand vise, first setting the hammer at full cock, or taking it out.

In models of 1873 and 1876: After removing the side plates and links, take out the link pin and retractor; the piston can then be pulled out with the fingers, first removing the hammer or setting it at full cock. Should the main spring require strengthening it can be done by turning up the strain-screw, which will be found directly under it, on the under side of the frame.

Remington's Rifle Cane —(*Made by E. Remington & Sons Ilion, N. Y.*)—Directions for using: To load, unscrew the handle or breech from the body of the cane; insert the cartridge and replace the handle, drawing back the handle will cock the piece ready for firing, when pressing on the trigger knob underneath will discharge it. Do not press on the trigger-knob when the piece is being cocked.

The lock-case or breech may be closed by a slight pressure upon the spring sight.

For hunting or target practice, remove the tip or ferule at the muzzle. If it is required to use the arm suddenly, as for self-defense, it is not necessary to remove the tip.

To remove the lock-case, remove the ferule under the handle by driving it down, take out the pin under the ferule, draw out the handle, draw the cane to full cock and press down and back the trigger, unscrew the lock from the barrel and push the cock out at the top end of the case.

In replacing the lock be careful to get the slot on a line with the guide inside of the case, and press down the sight spring.

Billings' Breech Loading Shot Gun.—(*Made by Billings & Spencer, Hartford, Conn.*)—This arm is provided with a backward and upward moving breech block in the rear of the cartridge, the breech block turning backward upon the hinge, which is a more natural motion than a forward turn.

To open the breech for loading, half cock the piece; draw the locking bolt with small handle on right side, and pull towards you; this retracts the firing pin, also extracts the shell automatically at the same time.

The Fox Breech Loading Shot Gun.—(*Made by American Arms Co., Boston, Mass.*)—To take apart: To detach the barrels, first open the gun as if for loading, which is done by pressing forward the thumb-piece on the top of the stock; then with the left thumb at a point about two inches from the end of the barrels, press the barrels towards the right and the gun is in position to load. Next turn the gun over in the right hand, holding it by the small of the stock, the end of the stock under the elbow supporting the weight of the gun; with the left thumb press the extractor home, and, with the thumb placed on the extractor spring, as close up to the fore end as convenient, press down the extractor firmly, and gently swinging the stock to the right until the detachment is obtained

To attach the barrels again, grasp the barrels with the plate up, so that the large screw at the head of the plate comes about at the center of the hand; be sure that the extractor is home. Place the opening for the screw which is in the breech-plate, over the screw, with the stock at an angle of about forty-five degrees with the barrels, at the same time put the left thumb on the end of the fore end, holding it firmly and flat on the plate, the stock-plate covering the guide-pin next the screw on the barrels, but not the pin on the extractor, gently move the stock until the two plates come into perfect contact, when the barrel will swing into position.

To remove the extractor, detach the barrels from the stock, lay them on a table with the plate up and muzzle from gun; pull out the extractor as far as it will come readily, then turn it to the *left* until the short arm strikes end of the barrels; now draw it straight out, meanwhile holding a finger over the extractor button to prevent its springing out and getting lost, when the button and locking stud will fall out of their own weight.

To replace the extractor, lay the extractor button in its cavity and slide the long shank of the extractor through it, then place the locking stud in position, holding it snug against the rear end of its seat, run the extractor into it, solid home, and turn to the *right* till the short arm is opposite its hole, when push straight in.

To take out firing pins, remove the screw holding them, which will be found in the breech-piece at the rear of the scroll-fence.

The Lefever Hammerless Gun.—(*Made by Daniel Lefever, Syracuse, N. Y.*)—Locks are rebounding.

To take apart: To take off the lock, see that both hammers are down; take out lever-screw; remove lever; turn out lock plate screw and drive off right hand lock by tapping on head of lock plate screw; take out the screw and insert in sear hole, and drive off left hand plate.

To take out the hammers, turn in the screws in bottom of the frame until the mainspring will allow the hammer to drop back far enough to allow its being lifted out of the frame. In putting back, be careful to press the projection on the lever on top of the spring that holds it, up to place, before putting the lever-screw in.

Parker Double-barreled Breech-loading Shot Gun. (*Made by Parker Brothers, Meriden, Conn.*)—1.

Finger piece. 2. Guard. 3. Lifter. 4. Locking bolt screws. 5. Locking bolt. 6. Barrel lug. 7. Trip. 8. Trip spring. 11. Extractor. 13. Joint Roll. The finger piece is solid and a part of lifter.

Pressing up the finger piece in front of guard raises the lifter, and its beveled side coming in contact with the locking bolt screw, acts as a wedge to draw the locking bolt from the mortise in the lug, and releases the barrels so that they tilt upward ready to receive the cartridges. When the bolt is back to the position shown in Fig. 2, the small hole which is drilled in the under side of the bolt comes directly over the trip, which, by the assistance of the trip spring, is made to enter the hole in the bolt and thereby hold it in position.

For cleaning, it can be very easily removed by taking off the locks and removing the locking bolt screw from the end of the locking bolt, then press down on the trip, which will allow the lifter to be withdrawn without removing either stock, guard or trigger-plate.

To replace the plunger: Withdraw the cone with a common screw-driver, by pressing it against the plunger until the screw-driver enters the slot. After removing the plunger and spring, be careful to replace them with spring at side of plunger.

Remington Double-barreled Breech-loading Shot Gun. (*Made by E. Remington & Sons, Ilion, N. Y.*) —A, thumb piece; B, lever, engaging locking bolt; C, pivot of lever B; D, locking point; H, joint check; K, pivot pin; L, joint check screw, limiting motion of barrels; M, hammer lifter; N, extractor; O, wire, a shoulder of which rests against P; P, shoulder of dog engaging locking bolt; S, snap action spring.

To take apart: To remove the barrels, take off the tip-stock, full cock both hammers and press the thumb-piece (between the hammers, and used for unlocking the barrels for loading) upward as far as it will go. The barrels can thus be detached.

In Fig. 3, the locking bolt is drawn as far as the shoulder P will allow it to move. This shoulder P is formed on one side of a little dog, in the other side of which is a corresponding shoulder, resting against the wire O. So long as the tip-stock is in place this dog cannot yield or permit the locking-bolt to be drawn far enough to allow the joint-check to come out of the mortise in the frame; but when the tip-stock is removed, the wire O can slip part way out, as in Fig. 4, allowing the shoulder P to move back, so that the locking-bolt can be drawn back clear of the joint-check—thus releasing the barrels.

The Roper Four shooting Shot-gun and Rifle. (*Made by the Billings & Spencer Co., Hartford, Conn.*) —A, frame; B, receiver; B^1, hinged lid of receiver; C, hammer; D, plunger; D^1, head of plunger; E, plunger link; F, cartridges; G, carrier in which shells are placed; H, lever to revolve carrier; I, mainspring; J, sear; *a*, ratchet; *b*, stirrup; *c*, link connecting hammer with mainspring; *d*, pin of lever H; *e*, pivot of carrier G; *f*, firing pin; *h*, elastic tail of lever H.

To take apart: To take the gun apart, turn in the set screw on under side of cylinder forward of the guard plate screw, until it comes to a stop. Then bring the hammer to cock notch and unscrew the cylinder from breech. N. B.—This set screw turns *in* to take the gun apart, and turns *out* to fasten the cylinder.

In putting the gun together, screw up the breech until the set screw can be replaced. This screw should be turned sufficiently tight to prevent any looseness of the breech.

To take off the stock and expose the lock, take out the long screw that runs through the small, rear end of receiver on top, and the screw in the guard plate which fastens it to the receiver underneath in front. Then remove the stock, and the working parts are exposed and can be readily cleaned and oiled. The firing pin should be detached occasionally, cleaned and oiled, as its easy working insures certain fire. To do this, take out the small screw in the top of the hammer and remove the piston entirely from the receiver, and the piston and firing pin are readily separated. In replacing the piston, care should be taken to put it in right side up the retractor spring being at the bottom. Never attempt to take out the screw which fastens the link to the piston, until the firing pin is detached.

Colt's Revolver For Army Use, Cal. 45.—(*Made by the Colt Pat. Fire Arms Co., Hartford, Conn.*)— A, barrel; B, Frame; B^1, recoil plate, C, cylinder; DD, firing pan; D^1, center pin bushing; E, guard; F, back strap; G, hammer; H, main spring; I, hammer roll and rivet; J, hammer screw; K, hammer cam; L, hand and hand spring; M, bolt and screw; N, trigger and screw; O, hammer notches. P, firing pin and rivet; Q, ejector rod and spring; Q^1, ejector tube; R, ejector head; S, ejector tube screw; T, short guard screw; U, seat and bolt spring (combined) and screw. V, back strap screw; W, main spring screw; X, front sight; Y, center pin catch screw.

To take apart: To dismount the pistol, half-cock the hammer, loosen the centre pin catch screw; draw out the centre pin, open the gate, and the cylinder can then be withdrawn. To remove the ejector, turn out the ejector tube screw, then push the front end away from the barrel and pull it towards the muzzle. The stock can be removed by turning out the two screws just behind the hammer, and that at the bottom of the strap. Remove the main spring and trigger guard; the parts of the lock can then be readily separated. The cylinder bushing should then be pushed out for cleaning. To remove the gate, turn out a screw in the lower side of the frame (hidden by the trigger guard), then the gate spring and catch can be withdrawn, and the gate can be pushed out.

To assemble the pistol, follow the directions for dismounting in reverse order. The mainspring is most conveniently mounted by turning in the screw part way, then swinging around the front end of the main spring until it bears against the under side of the friction roll. The cylinder bushing should be

frequently removed for cleaning.

North's Patent Revolving Pistol.—To take the pistol apart, take out the screw in the forward end of the lock and barrel frame, which runs through the base-pin, then draw back the operating lever so as to bring the hammer to the half-cock, turn the cylinder round by hand until the mortise in the back end of the cylinder is found, which mortise connects the cylinder with the recoil shield; then unlock the rammer and draw it and the base-pin out; the cylinder is then left free to be taken out. When the cylinder is taken out be careful not to leave the spiral spring which lays in a recess made in the front end of the cylinder, and in putting together be careful to replace this spring.

To take the lock apart, first take out the main and lever springs which are both held by one screw; then take out the hammer, next the small screw connecting the lever with the link of the toggle-joint (this screw is in the lever on the outside of the pistol just back of the trigger). Next bend up the toggle-joint and take out the lever and trigger, which are both held by one screw; then take out the toggle-joint and revolving lever, which are connected together by two screws.

To put the lock together, first put in the toggle-joint, then the main and lever springs, next the hammer, then the lever and trigger; next screw the revolving lever to the toggle-joint.

To put the cylinder in its place, first put the recoil shield (the piece with ratchets made for turning the breech) into its place and draw back the operating lever so that the hammer will come to full cock, at the same time pressing back the recoil shield as far as it will go, still holding back the operating lever; see that the spiral spring is in place in front of the cylinder, put the cylinder in place, let the projecting pin on the recoil shield come into the mortise in back end of cylinder; then put base-pin and rammer to place and turn in the screw which holds it.

The Remington Revolver (Smoot's Patent, made by E. Remington & Sons, Ilion, N. Y.)—To load: Half-cock the hammer; then turn the cylinder around so as to bring the chambers in line with the opening in the recoil shield, in which position the cartridges can be inserted, or the empty shells extracted by means of the rammer on the side of the barrel.

To remove the cylinder: Half-cock the hammer, then slide forward the stud in front of the cylinder through which the extractor rammer operates. The cylinder is replaced in the same way, but it is generally necessary to turn it in its seat to get the pawl out of the way before the centre pin will enter the hole in the cylinder.

To take the arm apart for cleaning: Remove the cylinder; then take out the two screws for holding the guard to the frame. When the guard is taken off, all the lock work is accessible for cleaning.

In order to keep a revolver in good condition, the cylinder should be taken out and oiled before putting it away after firing. The centre pin should be removed and cleaned to prevent it from rusting and impeding the rotation of the cylinder.

The Remington Magazine Pistol—(*Rider's Patent. Made by E. Remington & Sons, Ilion, N. Y.*)—To load: Draw the tube from the magazine; hold the pistol barrel upright; drop the cartridge, rim downwards, into the magazine; when full, insert the feeding tube in the magazine and lock in place by turning the cape and engaging catch in the notch under the barrel.

To fire: Grasp the pistol in the usual manner, press the thumb upon the breech-block, carrying the block downward until released from the recoil shoulder; then draw the block and hammer backward until the hammer engages in the cock notch; then let the block forward by an easy motion and the cartridge will be carried into the chamber; the pistol will remain at full cock and is discharged by pulling the trigger. In case the pistol should be loaded, and cocked, and not needed for use, the cartridge in the chamber may be returned to the magazine by simply drawing back the breech and pressing the carrier downward until the cartridge is in position to enter the magazine, then letting the block forward. This is to insure safety in carrying. The principle of this arm is such that the same motion cocks the hammer and carries the charge from the magazine to the chamber.

Schofield, Smith & Wesson Revolver, cal. 45.—(*Made by Smith & Wesson, Springfield, Mass.*)—To dismount the pistol: The only part of the pistol which will ordinarily require removal is the cylinder, which can be taken out as follows: Turn the cylinder catch just 180 deg., as indicated by the notch on its head; open the pistol; press up the head of the catch until it clears the cylinder; draw out the cylinder; replace it in inverse order.

To remove the cylinder and ejector of the pocket pistols, open the pistol until the piston protrudes half way, raise the barrel catch and turn the cylinder *two* turns to the *left*.

To replace the cylinder and ejector, open the pistol to its full capacity, raise the barrel catch, press the cylinder forward upon the base pin and give it *two* turns to the *right*.

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